PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-354893
(43)Date of publication of application : 24.12.1999

(51)Int.Cl. H01S 3/18
G11B 7/125

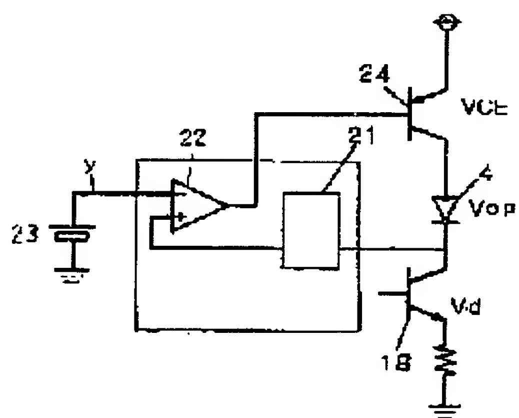
(21)Application number : 11-099681
(22)Date of filing : 07.04.1999

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : KAMIOKA YUICHI
KOISHI KENJI
MIYAHATA YOSHIYUKI
NAKAMURA NAOYUKI
TATEHARA KENICHI
HIDAKA IKUO
NAKAMORI KIYOSHI

(30)Priority
Priority number : 10 97254 Priority date : 09.04.1998 Priority country : JP

(54) SEMICONDUCTOR LASER DRIVER AND DRIVING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To drive a multilevel semiconductor laser current stably with high accuracy at high speed by keeping a voltage being applied to the output section of a semiconductor laser driver at a constant level and setting the power supply voltage to minimize a voltage being applied to the output section within the operable range of the driver.
SOLUTION: When a drive current is drawn out from the cathode side of a semiconductor laser 4, a voltage detecting section 21 detects the collector voltage of a transistor 18 at the output section of a laser driver. Output signal from the voltage detecting section 21 is the voltage comparion section 22 and compared with the voltage of a reference voltage supply 23 and comparison result is fed back to a power supply transistor 24 in order to control the collector voltage of the transistor 18 at a constant level during recording, erasing and reproducing operations. When the collector voltage of the transistor 18 is set at a minimum operable level, i.e., a minimum level causing no bottoming saturation, generation of heat in the laser drive current output section can be kept at a minimum level.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] With the semiconductor laser driving gear for performing playback of data, and record of data using an optical disk As opposed to the highest frequency f when carrying out light modulation of the semiconductor laser to the shape of a pulse (f> 0) Build-up-time Ta (Ta> 0) of said light modulation wave and the relation of fall-time Tb (Tb> 0) Ta<0.5x0.5/f, The semiconductor laser driving gear characterized by approaching the conditions of 5 cm>L>0 in the distance L between said semiconductor laser driving gears and said semiconductor laser so that it may be set to Tb<0.5x0.5/f.
[Claim 2] Said semiconductor laser driving gear is a semiconductor laser driving gear according to claim 1 characterized by being carried in the same moving part as an optical pickup.
[Claim 3] Said semiconductor laser driving gear N individual (N P laser power setting signals (P is the natural number below N) chosen with the change timing signal input section and said change timing signal of N individual for choosing respectively the laser power setting signal of the laser power setting signal input part of natural number), and said N-ary The semiconductor laser driving gear according to claim 2 which has the current source which supplies a drive current to semiconductor laser according to said P laser power setting signals added by the signal adder unit and said signal adder unit for adding.
[Claim 4] The laser power setting signal of said N individual is a semiconductor laser driving gear according to claim 3 characterized by taking a current input gestalt.
[Claim 5] It is the semiconductor laser driving gear according to claim 3 characterized by the M timing signal input sections (M being the natural number below N) having the input gestalt of a differential mold among the change timing signal input means of said N individual.
[Claim 6] The semiconductor laser driving gear according to claim 3 which has the armature-voltage control section of the power supply section and power supply section for controlling the electrical-potential-difference value concerning the semiconductor laser drive output section of said semiconductor laser driving gear to constant value as compared with a reference value.
[Claim 7] The semiconductor laser driving gear according to claim 6 characterized by controlling said power supply section so that the electrical-potential-difference value concerning said semiconductor laser driving gear output section turns into the minimum value of said semiconductor laser driving gear output section which can be operated.
[Claim 8] Said power supply section is a semiconductor laser driving gear according to claim 6 characterized by being prepared outside the same moving part as said optical pickup.
[Claim 9] By the semiconductor laser drive approach for performing playback of data, and record of data using an optical disk As opposed to the highest frequency f when carrying out light modulation of the semiconductor laser to the shape of a pulse (f> 0) Build-up-time Ta (Ta> 0) of said light modulation wave and the relation of fall-time Tb (Tb> 0) Ta<0.5x0.5/f, The semiconductor laser drive approach characterized by approaching the conditions of 5 cm>L>0 in the distance L between said semiconductor laser driving gears and said semiconductor laser so that it may be set to Tb<0.5x0.5/f.
[Claim 10] The current mechanical component of said semiconductor laser is the current drive approach according to claim 9 characterized by being carried in the same moving part same with said semiconductor laser as said optical pickup.
[Claim 11] The semiconductor laser drive approach according to claim 10 which inputs the laser power setting signal of N individual (N is the natural number) by said current drive approach, chooses the laser power setting signal of said N individual with the change timing signal of N individual, adds said P selected laser power setting signals (P is the natural number below N), and supplies the drive current according to said added setting signal to said semiconductor laser.
[Claim 12] The laser power drive approach according to claim 11 characterized by making the laser power

setting signal of said N-ary into a current input.
[Claim 13] The semiconductor laser drive approach according to claim 11 characterized by transmitting M change timing signals (M being the natural number below N) with a differential signal among the change timing signals of said N individual.
[Claim 14] The semiconductor laser drive approach according to claim 11 which observes the electrical potential difference of said semiconductor laser drive output section, controls the electrical potential difference of the power supply section which supplies a current to said semiconductor laser and the drive output section based on said observed value, and controls the electrical potential difference of said semiconductor laser drive output section to become a fixed electrical potential difference.
[Claim 15] The semiconductor laser drive approach according to claim 14 which controls the supply voltage to said semiconductor laser drive output section to become the minimum value of said drive output section which can be operated.
[Claim 16] Said power supply section is the semiconductor laser drive approach according to claim 14 characterized by supplying a current to the semiconductor laser and semiconductor laser current mechanical component which were prepared in the field outside the same moving part as said optical pickup, and were carried in the same moving part as an optical pickup.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the semiconductor laser control carried in the optical pickup of an optical disk unit.
[0002]
[Description of the Prior Art] An optical disk unit emits light in the semiconductor laser carried in the optical pickup. The reflection factor of the pit which condenses a feeble playback light on a disk at the time of playback, and is recorded on the disk, Phase contrast, a deflection angle, etc. are detected and read, semiconductor laser is made to emit light by power higher than the time of playback at the time of record, laser power is modulated according to the information to record, it records on a disk, laser power almost near at the time of record is irradiated on a disk at the time of elimination, and the Records Department is eliminated.
[0003] For example, fundamentally, in record to a phase-change optical disk, binary [of peak power and bias power] is switched, it records a mark in the peak power section, and eliminates a record mark in the bias power section.
[0004] However, in order to form the record mark stabilized in fact, it is insufficient, and two or more values more than binary need to be laser power switched of binary switching because of the purpose which equalizes the heating value applied to the mark which should be recorded, or the purpose which adjusts the heat balance of an edge always [mark] as shown in drawing 1 .
[0005] Record playback of an optical disk is also accelerated in recent years, and rapidity has come to be needed more also for the switching operation of the above-mentioned semiconductor laser.
[0006] When it is going to realize the record pulse shown in drawing 1 at the time of high-speed record and the pulse shape of semiconductor laser is not fully accelerated, as shown in drawing 2 , laser power will not reach to desired peak value, but the heating-value imbalance to a record mark will arise, and a record mark will be distorted.
[0007] Moreover, in the PWM record which has information in the edge before and after a record mark, since it is necessary to control the edge location of a record mark correctly, the record pulse with shorter standup of a record pulse and fall time is demanded.
[0008]
[Problem(s) to be Solved by the Invention] By the optical pickup which carried the semiconductor laser adopted conventionally, and the method which the semiconductor laser driving gear has separated, the drive current of semiconductor laser is usually transmitted with a flexible cable etc. In this case, the switching characteristic of a drive current gets worse with distributed constants, such as parasitic capacitance of a flexible cable.
[0009] That is, aggravation of this switching characteristic serves as evil for accelerating an optical disk unit.
[0010] This invention relates to power-saving for solving the problem of the heat centralization generated with the improvement to the above-mentioned evil, and an improvement.
[0011] Drawing 3 indicates build-up-time Tr of the semiconductor laser drive current when switching semiconductor laser in the shape of a pulse, and the relation of the fall time Tf to be the semiconductor laser of an optical disk unit, and the capacity component which is parasitic on the conductor between driving gears etc.
[0012] Before the high frequency component of the pulse current transmitted is transmitted to semiconductor laser, it is bypassed through capacity, and build-up-time Tr of a driving pulse wave of

semiconductor laser and the fall time Tf become large as a capacity component will increase, if its attention is paid to the above-mentioned capacity component. That is, the record pulse which became blunt as shown in drawing 2 is approached.

[0013] Temporarily, if the pulse of the highest frequency f1 is needed in a semiconductor laser driving pulse, as for pulse width, 0.5/f1 becomes minimum pulse width. therefore, conditions which do not have the amplitude fall of a driving pulse in the pulse of a frequency f1 Tr -- < -- 0.5x0.5/f1 Tf -- < -- 0.5x0.5/f1 (formula 1)

It becomes.

[0014] For example, the highest frequency = for 60MHz pulse switching implementation, it is required from a formula 1 that both Tr and Tf should be 4.16 or less ns.

[0015] In order to realize Tr and Tf<4.16ns from the experimental result shown in drawing 3 , 10pF or less can say that a parasitic capacitance component is required. In order to fulfill these conditions, it is required to contiguity-ize distance between semiconductor laser and a laser mechanical component within 5cm.

[0016] Therefore, in order to attain high-speed laser switching, for the distributed constant between a laser driving gear and semiconductor laser, and the purpose which mainly reduces a capacity component, between a laser driving gear and semiconductor laser is made to approach, namely, it is necessary to carry a laser driving gear on the optical pickup in which semiconductor laser is included. Or it is necessary for the same moving part as an optical pickup to attach a laser driving gear. However, it is the problem of the heat generated from semiconductor laser and a laser driving gear to become a problem in this case.

[0017] At the time of data logging to an optical disk, the semiconductor laser drive current Iop is Td=K1xVdxIop, when the electrical potential difference which amounts to several 100mA and is built over the driving gear output section is set to Vd and a proportionality constant is set to K1. (formula 2)

********** occurs in a driving gear.

[0018] Since a laser driving gear and semiconductor laser need to approach in order to make small effect of a parasitic capacitance division-into-equal-parts cloth constant, and it is necessary to arrange them, they conduct the heat generated with the driving gear also to semiconductor laser, as mentioned above.

[0019] It gets worse, more drive currents Iop are needed, and the relation (differential effectiveness) of the laser luminescence power P to the drive current Iop accelerates the temperature rise of a driving gear from a formula 1 further, so that the drive properties of semiconductor laser differ greatly and serve as an elevated temperature with temperature.

[0020] Moreover, itself is a source of generation of heat, and semiconductor laser is Vop and a proportionality constant about the operating voltage of semiconductor laser K2, then Tld=K2xVopxIop (formula 3)

It becomes **********. That is, it is the temperature rise of K3, then semiconductor laser about the conductivity of the heat from a drive circuit to semiconductor laser. Tld=K2xVopxIop+K3xK1xVdxIop (formula 4)

It becomes.

[0021]

[Means for Solving the Problem] Control of control of the drive current Iop, proportionality constants K1 and K2, and thermal conductivity K3 and control of the electrical potential differences Vd and Vld concerning the driving gear output section can be considered as a solution means of the above trouble.

[0022] Iop is the property of a semiconductor laser proper and proportionality constants K1, K2, and K3 are dependent on an optical pickup configuration and a thermal design. Moreover, although Vop is also changed according to the drive current Iop, the amount of fluctuation is decided by diode voltage and internal series resistance, and is the value of a semiconductor laser proper fundamentally.

[0023] Therefore, generation of heat of the optical head section is controlled by controlling the electrical potential difference Vd concerning the laser driving gear output section.

[0024] The power supply section which controls the electrical potential difference supplied to the laser driving gear output section in order to control Vd is prepared, and the electrical potential difference of the laser driving gear output section is supervised, it controls by feeding back the difference to a power supply section as compared with the electrical potential difference used as criteria so that Vd can always maintain constant value, and further, within limits which can be drive operated, the laser driving gear output section sets up the electrical potential difference of a power supply section so that Vd may become the minimum value.

[0025] The above-mentioned power supply section installs in locations other than the optical pickup in which semiconductor laser and a semiconductor laser driving gear are carried. That is, the surplus exoergic section is isolated in the location which does not participate in the semiconductor laser section thermally.

[0026] Even if it furthermore changes the supply voltage of an optical disk unit with fluctuation of AC Rhine electrical potential difference, fluctuation of a load, other variations, etc., Vd of the semiconductor laser driving gear output section is kept constant, and generation of heat within an optical pickup stops being always related to these fluctuation.
[0027] Thus, generation of heat in the optical pickup section can always be controlled by maintaining the electrical potential difference Vd concerning the laser driving gear output section at the minimum electrical potential difference which can be operated in the minimum condition, and the high speed semiconductor laser drive stabilized as a result can be realized.
[0028]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained.
[0029] The system configuration Fig. of an optical disk record regenerative apparatus is shown in drawing 4 . The roll control of the optical disk 1 is carried out in the fixed direction by the spindle motor 2. 3 is an optical pickup for performing record playback of data to an optical disk 1.
[0030] Drawing 5 contains the laser driving gear with the block diagram of an optical pickup 3. Semiconductor laser 4 outputs laser beam a according to the drive current Iop supplied from the laser driving gear 5. Laser beam a outputted from semiconductor laser 4 is made into parallel light with a collimate lens 6, it passes a beam splitter 7 and incidence is carried out to an objective lens 8. With an objective lens 8, a laser beam is condensed and the focus of the condensing spot is carried out to the data-logging side of an optical disk 1.
[0031] The laser beam reflected by the recording surface turns into parallel light with an objective lens 8 again, changes an optical path and is condensed by the beam splitter 7 at a photodetector 9.
[0032] The reflected light of an optical disk 1 is changed into an electrical signal by the photodetector 9, and is inputted into the servo block 10 of drawing 4 . Focal control and tracking control are made according to the electrical signal of a photodetector 9.
[0033] b, c, d and e, i.e., focal signal +, which are shown by drawing 4 and drawing 5 , focal signal −, tracking signal +, and tracking signal − are inputted into the servo block 10. With a servo block, a tracking error signal is made from focal error signal and tracking signal + and tracking signal − from focal signal + and focal signal −.
[0034] Current amplification of a focal error signal and the tracking error signal is carried out, they are told to the actuator 11 of an optical pickup 3, and position control is carried out so that the outgoing radiation light of an optical pickup 3 may condense on the recording surface of an optical disk 1.
[0035] Moreover, the focal signals b and c and the tracking signals d and e which are outputted from a photodetector 9 are inputted into the regenerative-signal processing block 12 at coincidence, and the signal component of the high frequency band in a signal is detected as information data currently recorded as a pit on the optical disk.
[0036] In the record signal-processing block 13, modulation, laser power which carries out format conversion and which is shown later, and timing control are performed for external input data to optical disks.
[0037] The Maine control block 14 is controlling the above regenerative-signal processing block 13 and the record signal-processing block 12.
[0038] The power and the record mark of semiconductor laser when recording a mark on a phase-change optical disk as an example are shown in drawing 6 . The peak power 1 (PEAK1) and the peak power 2 (PEAK2) are the power for forming a record mark on an optical disk 1. The bias power 1 (BIAS1) is the power for eliminating the mark recorded on the substrate. The bias power 2 (BIAS2) is the power for reducing heat are recording of a mark.
[0039] Moreover, about the area which is not recorded, playback power (READ) is always turned on.
[0040] That is, this example means needing a laser power setup of five values for data logging to an optical disk, and playback.
[0041] The block diagram of a semiconductor laser driving gear is shown in drawing 7 . A playback power programmed-current input (IINRD), the peak power 1 programmed-current input (IINPK1), the peak power 2 programmed-current input (IINPK2), the bias power 1 programmed-current input (IINBS1), and the bias power 2 programmed-current input (IINBS2) are inputted into the current input buffer section 15 from the record signal-processing block 13, respectively.
[0042] By taking a current input gestalt, a power setting signal can make the impedance of an electrical transmission way small, and makes effect of a noise the minimum in the long transmission line by a flexible cable etc. In addition, as for Above IINRD, and IINPK1, IINPK2, IINBS1 and IINBS2, it is also possible for a current input to take not conditions but a volt input gestalt absolutely.

[0043] Timing signals are a playback power timing signal (RDMD), peak power 1 timing signal (PK1MD+, PK1MD-), peak power 2 timing signal (PK2MD+, PK2MD-), bias power 1 timing signal (BS1MD+, BS1MD-), and bias power 2 timing signal (BS2MD).
[0044] A power timing signal functions as an enable signal to the power programmed current inputted into the current buffer section 15 in a current driving gear.
[0045] The switching timing of the timing signal for realizing laser luminescence shown by drawing 6 is shown in drawing 8 . An active state and bias power 2 timing-signal BS2MD are also always active states in record or elimination area between playback power luminescence time amount, and playback power timing signal RDMD seldom needs rapidity as a switching speed. Therefore, in this example, the timing transmission system of the single end is taken about the above-mentioned 2 timing signals, and it is inputted into the single end logic input section 16.
[0046] In drawing 8 , BS2MD makes L level the active state. Peak power 1 timing-signal PK1MD, peak power 2 timing-signal PK2MD, and bias power 1 timing-signal BS1MD are a timing signal which needs high-speed switching at the time of record mark formation, take a differential gestalt, and are inputted into the differential logic input section shown in drawing 7 as drawing 8 shows them. The signal after the operation of the control signal of a difference input is defined as follows, respectively.
[0047]
PK1MD=(PK1MD+)- (PK1MD-) (formula 5)
PK2MD=(PK2MD+)- (PK2MD-) (formula 6)
BS1MD=(BS1MD+)- (BS1MD-) (formula 7)
If PK1MD of drawing 8 is taken for an example, PK1MD+ will make an active state the time of H level and PK1MD- being L level. It is possible to cancel a penetration noise component also in the long transmission line by a flexible cable etc. for the data transmission of a differential gestalt. moreover -- since the crossing point of a positive logic input and a negative logic input serves as an edge location of the result of an operation, ****** change of duty arises by voltage variation and the noise -- final difference -- affecting the duty after an operation decreases.
[0048] By the optical disk record approach which adopts as the die length of a record mark the PWM record which gives information, the duty shelf life of a record pulse is very important.
[0049] Under a definition, the relation of Iop is indicated to be each control line as follows above.
Iop=Gx (RDMDxIINRD +PK1 MDxIINPK1 +PK2 MDxIINPK2 +BS1MDxIINBS1 +BS2 MDxIINBS2) (formula 8)
It becomes. G is gain of a current mechanical component shown in 18 of drawing 7 .
[0050] a timing signal be make into a 2 signal differential type , distribute and it depend until it adopt an addition method as the creation of a scale and a semiconductor laser driving signal and finally carry out the addition composition of the improvement in precision by increase the reinforcement for a noise , and in order to deal with and process each element current of small level , it become that it be advantageous in calorific value , a switching characteristic , etc. in the buffer sections 15 , 16 , and 17 about the record and the elimination actuation which need a rapidity for control timing as mentioned above .
[0051] Drawing 9 and drawing 10 are drawings in which the configuration of the output section 18 of a semiconductor laser current driving gear was simplified and described.
[0052] Drawing 9 shows the method which supplies the drive current Iop in the direction sucked out of the cathode side of semiconductor laser 4, and drawing 1010 shows the method which supplies the drive current Iop in the direction slushed from the anode side of semiconductor laser 4.
[0053] The laser drive current Iop is several 100mA order, and depends the great portion of power consumed on an optical pickup on the laser drive current Iop. The power consumption on an optical pickup 3 is P=VCCxIop. (formula 9)
It can come out and express. VCC is supply voltage, and when VCC varies in the largest direction, power consumption serves as max. The items of VCC are the operating voltage Vop of semiconductor laser 4, and the operating voltage Vd of the drive output section 18 as they are shown in drawing 9 , and they are VCC=Vop+Vd. (formula 10)
It becomes. Although it is common to be transmitted by the flexible cable 20 from a main part 19 as VCC is shown in drawing 11 , and the voltage drop on a flexible cable etc. is considered, in this example, it is omitting for simplification. In addition, the regenerative-signal processing block 12, the record signal-processing block 13, the control block, etc. are mounted in the main part 19.
[0054] Moreover, the operating voltage Vop of semiconductor laser 4 changes with the operating currents Iop rather than is fixed. Generally it is diode voltage Vld, the internal resistance Rs, then Vop=Vld+IopxRs in semiconductor laser. (formula 11)
It is expressed. As mentioned above, it is if a formula 9 is rewritten. P=(Vop+Vd) xIop (formula 12)

= Vld+IopxRs+VdxIop (formula 13)
It becomes.
[0055] The relation of the drive current Iop is indicated to be the output light power of semiconductor laser 4 to drawing 12 .
[0056] Semiconductor laser emits light in the power proportional to the drive current Iop by making differential effectiveness eta into an inclination to the current more than a threshold current Ith. The above-mentioned property of semiconductor laser changes with degradation of operating environment temperature and the component by long duration use.
[0057] Although it is the graph which Ith1 and eta1 are ordinary temperature, respectively, and showed the relation of the output laser power pair drive current of the initial state of duration of service, the time of an elevated temperature, or after prolonged use, it shifts to the graph shown by Ith2 and eta2. That is, a drive current value required to carry out outgoing radiation of the fixed laser power P1 is set to Iop1 by the former, and is set to Iop2 (Iop1<Iop2) by the latter. Generation of heat of the laser driving gear 5 increases, and the temperature of semiconductor laser 4 rises as the formula 4 showed from the formula 2, when the drive current Iop increased. If temperature rises, there will be a possibility of leading to vicious circle of needing the still bigger drive current Iop, and power-saving on an optical pickup 3 will become important.
[0058] Although it is more effective in power saving of an optical head than a formula 9 and a formula 13 to make the drive current Iop small, the dependence to a semiconductor laser component is high, and control is difficult for a semiconductor laser drive current, the temperature characteristic, and secular change.
[0059] Therefore, power-saving becomes possible by controlling VCC from a formula 9, i.e., controlling the electrical potential difference Vd built over the laser driving gear output section from a formula 12.
[0060] Drawing 13 and drawing 14 are the circuits of the laser driving gear output section which incorporated the above-mentioned power-saving. Drawing 13 shows the case where it is based on the laser drive approach of the method which pulls out the drive current Iop from the cathode side of the semiconductor laser 4 shown by drawing 9 . The electrical-potential-difference detecting element 21 detects the collector voltage of the transistor 18 of the laser driving gear output section.
[0061] It is DC at the time of playback, and at the time of elimination, the collector current of a transistor 18 is a pulse-like at the time of record, and it is [it is a pulse-like or] DC. Therefore, the gate mold electrical-potential-difference detection equipment which synchronized with the period when the drive current of the peak power 2 at the time of record, the bias power 1 at the time of elimination, and each lead power at the time of playback is flowing as one example as an electrical-potential-difference detecting element 21 is suitable.
[0062] The output signal of the electrical-potential-difference detecting element 21 is the electrical-potential-difference comparator 22, it is compared with the electrical potential difference of the source 23 of reference voltage, and a comparison result is fed back to the power supply section transistor 24, and the collector voltage of a transistor 18 is always controlled by this example by the fixed electrical potential difference in each at the time of record, elimination, and playback.
[0063] If the collector voltage of a transistor 18 is set as the minimum value at the minimum value which can be operated, i.e., the range which does not carry out bottoming saturation, the calorific value in the laser drive current-output section is maintainable to min.
[0064] The above can also change the source 23 of reference voltage to the optimal value to each mode of record, elimination, and playback, although the source 23 of reference voltage is made into the fixed electrical potential difference.
[0065] Drawing 14 is the example which incorporated power-saving in the laser drive approach of the method which slushes the drive current Iop from the anode side of the semiconductor laser 4 shown by drawing 10 . The electrical-potential-difference detecting element 21 detects the collector voltage of the drive transistor 18 like the case of drawing 13 , and the output of the electrical-potential-difference detecting element 21 is compared with the electrical potential difference of the source 23 of reference voltage by the electrical-potential-difference comparator 22, and feeds back the result to the power supply section transistor 24.
[0066] Since the emitter electrical potential difference of the power supply section transistor 24 is the supply voltage of an optical disk unit, it produces variation, but since the source 23 of reference voltage consists of what has few voltage variation called a band gap, its collector voltage of a transistor 18 is stable in drawing 13 , also to a source effect.
[0067] Fluctuation part deltaPP of the power consumption of the transistor 24 by fluctuation part deltaVCE of collector voltage VCE of the power supply section transistor 24 is deltaPP=. deltaVCExIop (formula 14)

It becomes. Therefore, the power supply section transistor 24 brings a result which drives away a heat source to a main part from on an optical pickup also to a part for the line voltage variation of an optical disk unit by arranging in the location 19 separated from the optical pickup, for example, the main part shown in drawing 11 .

[0068] VCC shown by the formula 9 serves as a collector voltage of the power supply section transistor 24, and is a collector voltage VC, then P=VcxIop (formula 15)

On the other hand, since it is VC=Vop+Vd, it is from a formula 14. P=(Vop+Vd) xIop (formula 16)

= Vld+IopxRs+VdxIop (formula 17)

It becomes. Since Vop, Vld, and Rs are the values of semiconductor laser 3 proper and do not change, it turns out that the power consumption P of an optical pickup 3 is not influenced of a source effect.

[0069] Moreover, reduction of the power consumption on an optical head is attained a passage clear from formulas 16 and 17 by adjusting the electrical potential difference of the source 23 of reference voltage so that the laser driving gear output section electrical potential difference Vd may serve as the minimum value which can be operated.

[0070]

[Effect of the Invention] As mentioned above, a laser driving gear can be arranged like this example on the pickup in which semiconductor laser is included, generation of heat on an optical pickup can be suppressed to the minimum by adjusting the electrical potential difference Vd concerning the laser driving gear output section to the minimum value which can be operated, and it becomes possible to accelerate a multiple-value semiconductor laser current drive to stability with high precision. That is, more nearly high-speed record playback is realizable.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the semiconductor laser control carried in the optical pickup of an optical disk unit.

[Translation done.]

PRIOR ART

[Description of the Prior Art] An optical disk unit emits light in the semiconductor laser carried in the optical pickup. The reflection factor of the pit which condenses a feeble playback light on a disk at the time of playback, and is recorded on the disk, Phase contrast, a deflection angle, etc. are detected and read, semiconductor laser is made to emit light by power higher than the time of playback at the time of record, laser power is modulated according to the information to record, it records on a disk, laser power almost near at the time of record is irradiated on a disk at the time of elimination, and the Records Department is eliminated.
[0003] For example, fundamentally, in record to a phase-change optical disk, binary [of peak power and bias power] is switched, it records a mark in the peak power section, and eliminates a record mark in the bias power section.
[0004] However, in order to form the record mark stabilized in fact, it is insufficient, and two or more values more than binary need to be laser power switched of binary switching because of the purpose which equalizes the heating value applied to the mark which should be recorded, or the purpose which adjusts the heat balance of an edge always [mark] as shown in drawing 1 .
[0005] Record playback of an optical disk is also accelerated in recent years, and rapidity has come to be needed more also for the switching operation of the above-mentioned semiconductor laser.
[0006] When it is going to realize the record pulse shown in drawing 1 at the time of high-speed record and the pulse shape of semiconductor laser is not fully accelerated, as shown in drawing 2 , laser power will not reach to desired peak value, but the heating-value imbalance to a record mark will arise, and a record mark will be distorted.
[0007] Moreover, in the PWM record which has information in the edge before and after a record mark, since it is necessary to control the edge location of a record mark correctly, the record pulse with shorter standup of a record pulse and fall time is demanded.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, a laser driving gear can be arranged like this example on the pickup in which semiconductor laser is included, generation of heat on an optical pickup can be suppressed to the minimum by adjusting the electrical potential difference Vd concerning the laser driving gear output section to the minimum value which can be operated, and it becomes possible to accelerate a multiple-value semiconductor laser current drive to stability with high precision. That is, more nearly high-speed record playback is realizable.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the optical pickup which carried the semiconductor laser adopted conventionally, and the method which the semiconductor laser driving gear has separated, the drive current of semiconductor laser is usually transmitted with a flexible cable etc. In this case, the switching characteristic of a drive current gets worse with distributed constants, such as parasitic capacitance of a flexible cable.
[0009] That is, aggravation of this switching characteristic serves as evil for accelerating an optical disk unit.
[0010] This invention relates to power-saving for solving the problem of the heat centralization generated with the improvement to the above-mentioned evil, and an improvement.
[0011] Drawing 3 indicates build-up-time Tr of the semiconductor laser drive current when switching semiconductor laser in the shape of a pulse, and the relation of the fall time Tf to be the semiconductor laser of an optical disk unit, and the capacity component which is parasitic on the conductor between driving gears etc.
[0012] Before the high frequency component of the pulse current transmitted is transmitted to semiconductor laser, it is bypassed through capacity, and build-up-time Tr of a driving pulse wave of semiconductor laser and the fall time Tf become large as a capacity component will increase, if its attention is paid to the above-mentioned capacity component. That is, the record pulse which became blunt as shown in drawing 2 is approached.
[0013] Temporarily, if the pulse of the highest frequency f1 is needed in a semiconductor laser driving pulse, as for pulse width, 0.5/f1 becomes minimum pulse width. therefore, conditions which do not have the amplitude fall of a driving pulse in the pulse of a frequency f1 Tr -- < -- 0.5x0.5/f1 Tf -- < -- 0.5x0.5/f1 (formula 1)
It becomes.
[0014] For example, the highest frequency = for 60MHz pulse switching implementation, it is required from a formula 1 that both Tr and Tf should be 4.16 or less ns.
[0015] In order to realize Tr and Tf<4.16ns from the experimental result shown in drawing 3 , 10pF or less can say that a parasitic capacitance component is required. In order to fulfill these conditions, it is required to contiguity-ize distance between semiconductor laser and a laser mechanical component within 5cm.
[0016] Therefore, in order to attain high-speed laser switching, for the distributed constant between a laser driving gear and semiconductor laser, and the purpose which mainly reduces a capacity component, between a laser driving gear and semiconductor laser is made to approach, namely, it is necessary to carry a laser driving gear on the optical pickup in which semiconductor laser is included. Or it is necessary for the same moving part as an optical pickup to attach a laser driving gear. However, it is the problem of the heat generated from semiconductor laser and a laser driving gear to become a problem in this case.
[0017] At the time of data logging to an optical disk, the semiconductor laser drive current Iop is Td=K1xVdxIop, when the electrical potential difference which amounts to several 100mA and is built over the driving gear output section is set to Vd and a proportionality constant is set to K1. (formula 2)
********** occurs in a driving gear.
[0018] Since a laser driving gear and semiconductor laser need to approach in order to make small effect of a parasitic capacitance division-into-equal-parts cloth constant, and it is necessary to arrange them, they conduct the heat generated with the driving gear also to semiconductor laser, as mentioned above.
[0019] It gets worse, more drive currents Iop are needed, and the relation (differential effectiveness) of the laser luminescence power P to the drive current Iop accelerates the temperature rise of a driving gear from a formula 1 further, so that the drive properties of semiconductor laser differ greatly and serve as an

elevated temperature with temperature.

[0020] Moreover, itself is a source of generation of heat, and semiconductor laser is Vop and a proportionality constant about the operating voltage of semiconductor laser K2, then Tld=K2xVopxIop (formula 3)

It becomes **********. That is, it is the temperature rise of K3, then semiconductor laser about the conductivity of the heat from a drive circuit to semiconductor laser. Tld=K2xVopxIop+K3xK1xVdxIop (formula 4)

It becomes.

[Translation done.]

MEANS

[Means for Solving the Problem] Control of control of the drive current Iop, proportionality constants K1 and K2, and thermal conductivity K3 and control of the electrical potential differences Vd and Vld concerning the driving gear output section can be considered as a solution means of the above trouble.
[0022] Iop is the property of a semiconductor laser proper and proportionality constants K1, K2, and K3 are dependent on an optical pickup configuration and a thermal design. Moreover, although Vop is also changed according to the drive current Iop, the amount of fluctuation is decided by diode voltage and internal series resistance, and is the value of a semiconductor laser proper fundamentally.
[0023] Therefore, generation of heat of the optical head section is controlled by controlling the electrical potential difference Vd concerning the laser driving gear output section.
[0024] The power supply section which controls the electrical potential difference supplied to the laser driving gear output section in order to control Vd is prepared, and the electrical potential difference of the laser driving gear output section is supervised, it controls by feeding back the difference to a power supply section as compared with the electrical potential difference used as criteria so that Vd can always maintain constant value, and further, within limits which can be drive operated, the laser driving gear output section sets up the electrical potential difference of a power supply section so that Vd may become the minimum value.
[0025] The above-mentioned power supply section installs in locations other than the optical pickup in which semiconductor laser and a semiconductor laser driving gear are carried. That is, the surplus exoergic section is isolated in the location which does not participate in the semiconductor laser section thermally.
[0026] Even if it furthermore changes the supply voltage of an optical disk unit with fluctuation of AC Rhine electrical potential difference, fluctuation of a load, other variations, etc., Vd of the semiconductor laser driving gear output section is kept constant, and generation of heat within an optical pickup stops being always related to these fluctuation.
[0027] Thus, generation of heat in the optical pickup section can always be controlled by maintaining the electrical potential difference Vd concerning the laser driving gear output section at the minimum electrical potential difference which can be operated in the minimum condition, and the high speed semiconductor laser drive stabilized as a result can be realized.
[0028]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained.
[0029] The system configuration Fig. of an optical disk record regenerative apparatus is shown in drawing 4 . The roll control of the optical disk 1 is carried out in the fixed direction by the spindle motor 2. 3 is an optical pickup for performing record playback of data to an optical disk 1.
[0030] Drawing 5 contains the laser driving gear with the block diagram of an optical pickup 3. Semiconductor laser 4 outputs laser beam a according to the drive current Iop supplied from the laser driving gear 5. Laser beam a outputted from semiconductor laser 4 is made into parallel light with a collimate lens 6, it passes a beam splitter 7 and incidence is carried out to an objective lens 8. With an objective lens 8, a laser beam is condensed and the focus of the condensing spot is carried out to the data-logging side of an optical disk 1.
[0031] The laser beam reflected by the recording surface turns into parallel light with an objective lens 8 again, changes an optical path and is condensed by the beam splitter 7 at a photodetector 9.
[0032] The reflected light of an optical disk 1 is changed into an electrical signal by the photodetector 9, and is inputted into the servo block 10 of drawing 4 . Focal control and tracking control are made according to the electrical signal of a photodetector 9.
[0033] b, c, d and e, i.e., focal signal +, which are shown by drawing 4 and drawing 5 , focal signal -, tracking

signal +, and tracking signal − are inputted into the servo block 10. With a servo block, a tracking error signal is made from focal error signal and tracking signal + and tracking signal − from focal signal + and focal signal −.

[0034] Current amplification of a focal error signal and the tracking error signal is carried out, they are told to the actuator 11 of an optical pickup 3, and position control is carried out so that the outgoing radiation light of an optical pickup 3 may condense on the recording surface of an optical disk 1.

[0035] Moreover, the focal signals b and c and the tracking signals d and e which are outputted from a photodetector 9 are inputted into the regenerative-signal processing block 12 at coincidence, and the signal component of the high frequency band in a signal is detected as information data currently recorded as a pit on the optical disk.

[0036] In the record signal-processing block 13, modulation, laser power which carries out format conversion and which is shown later, and timing control are performed for external input data to optical disks.

[0037] The Maine control block 14 is controlling the above regenerative-signal processing block 13 and the record signal-processing block 12.

[0038] The power and the record mark of semiconductor laser when recording a mark on a phase-change optical disk as an example are shown in drawing 6 . The peak power 1 (PEAK1) and the peak power 2 (PEAK2) are the power for forming a record mark on an optical disk 1. The bias power 1 (BIAS1) is the power for eliminating the mark recorded on the substrate. The bias power 2 (BIAS2) is the power for reducing heat are recording of a mark.

[0039] Moreover, about the area which is not recorded, playback power (READ) is always turned on.

[0040] That is, this example means needing a laser power setup of five values for data logging to an optical disk, and playback.

[0041] The block diagram of a semiconductor laser driving gear is shown in drawing 7 . A playback power programmed-current input (IINRD), the peak power 1 programmed-current input (IINPK1), the peak power 2 programmed-current input (IINPK2), the bias power 1 programmed-current input (IINBS1), and the bias power 2 programmed-current input (IINBS2) are inputted into the current input buffer section 15 from the record signal-processing block 13, respectively.

[0042] By taking a current input gestalt, a power setting signal can make the impedance of an electrical transmission way small, and makes effect of a noise the minimum in the long transmission line by a flexible cable etc. In addition, as for Above IINRD, and IINPK1, IINPK2, IINBS1 and IINBS2, it is also possible for a current input to take not conditions but a volt input gestalt absolutely.

[0043] Timing signals are a playback power timing signal (RDMD), peak power 1 timing signal (PK1MD+, PK1MD−), peak power 2 timing signal (PK2MD+, PK2MD−), bias power 1 timing signal (BS1MD+, BS1MD−), and bias power 2 timing signal (BS2MD).

[0044] A power timing signal functions as an enable signal to the power programmed current inputted into the current buffer section 15 in a current driving gear.

[0045] The switching timing of the timing signal for realizing laser luminescence shown by drawing 6 is shown in drawing 8 . An active state and bias power 2 timing-signal BS2MD are also always active states in record or elimination area between playback power luminescence time amount, and playback power timing signal RDMD seldom needs rapidity as a switching speed. Therefore, in this example, the timing transmission system of the single end is taken about the above-mentioned 2 timing signals, and it is inputted into the single end logic input section 16.

[0046] In drawing 8 , BS2MD makes L level the active state. Peak power 1 timing-signal PK1MD, peak power 2 timing-signal PK2MD, and bias power 1 timing-signal BS1MD are a timing signal which needs high-speed switching at the time of record mark formation, take a differential gestalt, and are inputted into the differential logic input section shown in drawing 7 as drawing 8 shows them. The signal after the operation of the control signal of a difference input is defined as follows, respectively.

[0047]

PK1MD=(PK1MD+)− (PK1MD−) (formula 5)

PK2MD=(PK2MD+)− (PK2MD−) (formula 6)

BS1MD=(BS1MD+)− (BS1MD−) (formula 7)

If PK1MD of drawing 8 is taken for an example, PK1MD+ will make an active state the time of H level and PK1MD− being L level. It is possible to cancel a penetration noise component also in the long transmission line by a flexible cable etc. for the data transmission of a differential gestalt. moreover -- since the crossing point of a positive logic input and a negative logic input serves as an edge location of the result of an operation, ****** change of duty arises by voltage variation and the noise -- final difference --

affecting the duty after an operation decreases.
[0048] By the optical disk record approach which adopts as the die length of a record mark the PWM record which gives information, the duty shelf life of a record pulse is very important.
[0049] Under a definition, the relation of Iop is indicated to be each control line as follows above.
Iop=Gx (RDMDxIINRD +PK1 MDxIINPK1 +PK2 MDxIINPK2 +BS1MDxIINBS1 +BS2 MDxIINBS2) (formula 8)
It becomes. G is gain of a current mechanical component shown in 18 of drawing 7 .
[0050] a timing signal be make into a 2 signal differential type , distribute and it depend until it adopt an addition method as the creation of a scale and a semiconductor laser driving signal and finally carry out the addition composition of the improvement in precision by increase the reinforcement for a noise , and in order to deal with and process each element current of small level , it become that it be advantageous in calorific value , a switching characteristic , etc. in the buffer sections 15 , 16 , and 17 about the record and the elimination actuation which need a rapidity for control timing as mentioned above .
[0051] Drawing 9 and drawing 10 are drawings in which the configuration of the output section 18 of a semiconductor laser current driving gear was simplified and described.
[0052] Drawing 9 shows the method which supplies the drive current Iop in the direction sucked out of the cathode side of semiconductor laser 4, and drawing 1010 shows the method which supplies the drive current Iop in the direction slushed from the anode side of semiconductor laser 4.
[0053] The laser drive current Iop is several 100mA order, and depends the great portion of power consumed on an optical pickup on the laser drive current Iop. The power consumption on an optical pickup 3 is P=VCCxIop. (formula 9)
It can come out and express. VCC is supply voltage, and when VCC varies in the largest direction, power consumption serves as max. The items of VCC are the operating voltage Vop of semiconductor laser 4, and the operating voltage Vd of the drive output section 18 as they are shown in drawing 9 , and they are VCC=Vop+Vd. (formula 10)
It becomes. Although it is common to be transmitted by the flexible cable 20 from a main part 19 as VCC is shown in drawing 11 , and the voltage drop on a flexible cable etc. is considered, in this example, it is omitting for simplification. In addition, the regenerative-signal processing block 12, the record signal-processing block 13, the control block, etc. are mounted in the main part 19.
[0054] Moreover, the operating voltage Vop of semiconductor laser 4 changes with the operating currents Iop rather than is fixed. Generally it is diode voltage Vld, the internal resistance Rs, then Vop=Vld+IopxRs in semiconductor laser. (formula 11)
It is expressed. As mentioned above, it is if a formula 9 is rewritten. P=(Vop+Vd) xIop (formula 12)
= Vld+IopxRs+VdxIop (formula 13)
It becomes.
[0055] The relation of the drive current Iop is indicated to be the output light power of semiconductor laser 4 to drawing 12 .
[0056] Semiconductor laser emits light in the power proportional to the drive current Iop by making differential effectiveness eta into an inclination to the current more than a threshold current Ith. The above-mentioned property of semiconductor laser changes with degradation of operating environment temperature and the component by long duration use.
[0057] Although it is the graph which Ith1 and eta1 are ordinary temperature, respectively, and showed the relation of the output laser power pair drive current of the initial state of duration of service, the time of an elevated temperature, or after prolonged use, it shifts to the graph shown by Ith2 and eta2. That is, a drive current value required to carry out outgoing radiation of the fixed laser power P1 is set to Iop1 by the former, and is set to Iop2 (Iop1<Iop2) by the latter. Generation of heat of the laser driving gear 5 increases, and the temperature of semiconductor laser 4 rises as the formula 4 showed from the formula 2, when the drive current Iop increased. If temperature rises, there will be a possibility of leading to vicious circle of needing the still bigger drive current Iop, and power-saving on an optical pickup 3 will become important.
[0058] Although it is more effective in power saving of an optical head than a formula 9 and a formula 13 to make the drive current Iop small, the dependence to a semiconductor laser component is high, and control is difficult for a semiconductor laser drive current, the temperature characteristic, and secular change.
[0059] Therefore, power-saving becomes possible by controlling VCC from a formula 9, i.e., controlling the electrical potential difference Vd built over the laser driving gear output section from a formula 12.
[0060] Drawing 13 and drawing 14 are the circuits of the laser driving gear output section which incorporated the above-mentioned power-saving. Drawing 13 shows the case where it is based on the laser drive approach of the method which pulls out the drive current Iop from the cathode side of the semiconductor laser 4 shown by drawing 9 . The electrical-potential-difference detecting element 21

detects the collector voltage of the transistor 18 of the laser driving gear output section.
[0061] It is DC at the time of playback, and at the time of elimination, the collector current of a transistor 18 is a pulse-like at the time of record, and it is [it is a pulse-like or] DC. Therefore, the gate mold electrical-potential-difference detection equipment which synchronized with the period when the drive current of the peak power 2 at the time of record, the bias power 1 at the time of elimination, and each lead power at the time of playback is flowing as one example as an electrical-potential-difference detecting element 21 is suitable.
[0062] The output signal of the electrical-potential-difference detecting element 21 is the electrical-potential-difference comparator 22, it is compared with the electrical potential difference of the source 23 of reference voltage, and a comparison result is fed back to the power supply section transistor 24, and the collector voltage of a transistor 18 is always controlled by this example by the fixed electrical potential difference in each at the time of record, elimination, and playback.
[0063] If the collector voltage of a transistor 18 is set as the minimum value at the minimum value which can be operated, i.e., the range which does not carry out bottoming saturation, the calorific value in the laser drive current-output section is maintainable to min.
[0064] The above can also change the source 23 of reference voltage to the optimal value to each mode of record, elimination, and playback, although the source 23 of reference voltage is made into the fixed electrical potential difference.
[0065] Drawing 14 is the example which incorporated power-saving in the laser drive approach of the method which slushes the drive current Iop from the anode side of the semiconductor laser 4 shown by drawing 10 . The electrical-potential-difference detecting element 21 detects the collector voltage of the drive transistor 18 like the case of drawing 13 , and the output of the electrical-potential-difference detecting element 21 is compared with the electrical potential difference of the source 23 of reference voltage by the electrical-potential-difference comparator 22, and feeds back the result to the power supply section transistor 24.
[0066] Since the emitter electrical potential difference of the power supply section transistor 24 is the supply voltage of an optical disk unit, it produces variation, but since the source 23 of reference voltage consists of what has few voltage variation called a band gap, its collector voltage of a transistor 18 is stable in drawing 13 , also to a source effect.
[0067] Fluctuation part deltaPP of the power consumption of the transistor 24 by fluctuation part deltaVCE of collector voltage VCE of the power supply section transistor 24 is deltaPP=. deltaVCExIop (formula 14)
It becomes. Therefore, the power supply section transistor 24 brings a result which drives away a heat source to a main part from on an optical pickup also to a part for the line voltage variation of an optical disk unit by arranging in the location 19 separated from the optical pickup, for example, the main part shown in drawing 11 .
[0068] VCC shown by the formula 9 serves as a collector voltage of the power supply section transistor 24, and is a collector voltage VC, then P=VcxIop (formula 15)
On the other hand, since it is VC=Vop+Vd, it is from a formula 14. P=(Vop+Vd) xIop (formula 16)
= Vld+IopxRs+VdxIop (formula 17)
It becomes. Since Vop, Vld, and Rs are the values of semiconductor laser 3 proper and do not change, it turns out that the power consumption P of an optical pickup 3 is not influenced of a source effect.
[0069] Moreover, reduction of the power consumption on an optical head is attained a passage clear from formulas 16 and 17 by adjusting the electrical potential difference of the source 23 of reference voltage so that the laser driving gear output section electrical potential difference Vd may serve as the minimum value which can be operated.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the record pulse shape and the record mark of an optical disk
[Drawing 2] Drawing showing a wave when a "provincial accent" occurs to a record pulse and the amplitude falls, and the example of a record mark
[Drawing 3] The related Fig. of semiconductor laser, the capacity which is parasitic on the conductor between semiconductor laser mechanical components, and the pulse-shape build up time Tr and a fall time Tf
[Drawing 4] Optical disc system block diagram
[Drawing 5] Optical pickup block diagram
[Drawing 6] An optical disk record mark and the Fig. corresponding to semiconductor laser power
[Drawing 7] Semiconductor laser driving gear block diagram
[Drawing 8] The Fig. corresponding to semiconductor laser power and a timing signal
[Drawing 9] Laser driving gear output section block diagram
[Drawing 10] Laser driving gear output section block diagram
[Drawing 11] Optical head plot plan
[Drawing 12] The output-power pair drive current Fig. of semiconductor laser
[Drawing 13] Power-saving laser driving gear output section block diagram
[Drawing 14] Power-saving laser driving gear output section block diagram
[Description of Notations]
1 Optical Disk
2 Spindle Motor
3 Optical Pickup
4 Semiconductor Laser
5 Laser Driving Gear
6 Collimate Lens
7 Beam Splitter
8 Objective Lens
9 Photodetector
10 Servo Block
11 AKUCHIEETA
12 Regenerative-Signal Processing Block
13 Record Signal-Processing Block
14 Maine Control Block
15 Current Input Buffer Section
16 Single End Logic Input Section
17 Differential Logic Input Section
18 Laser Driving Gear Output Section
19 Main Part
20 Flexible Cable
21 Electrical-Potential-Difference Detecting Element
22 Electrical-Potential-Difference Comparator
23 Source of Reference Voltage
24 Power Supply Section Transistor
Laser beam

b Focal signal +
c Focal signal −
d Tracking signal +
e Tracking signal −

[Translation done.]

* NOTICES *

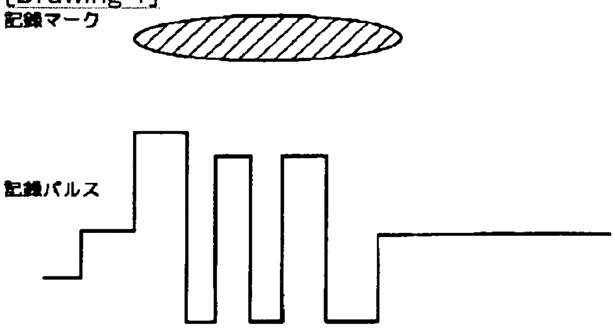
JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

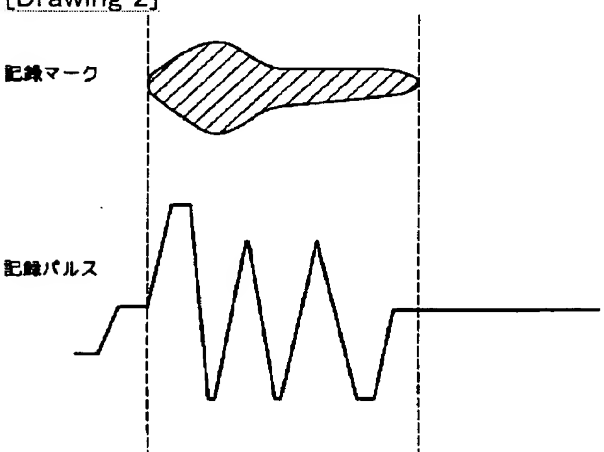
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

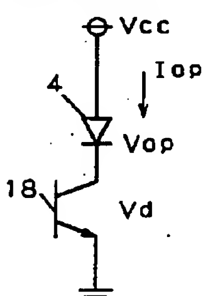
[Drawing 1]



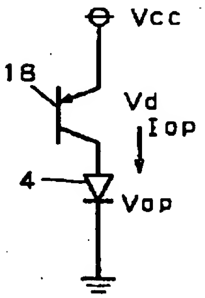
[Drawing 2]



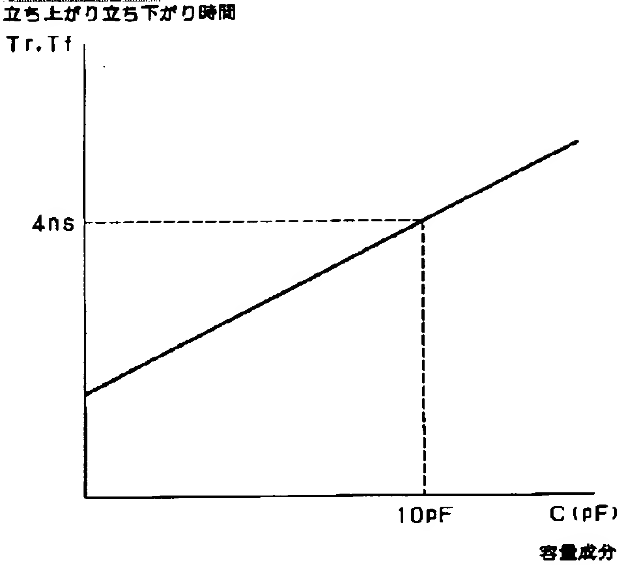
[Drawing 9]



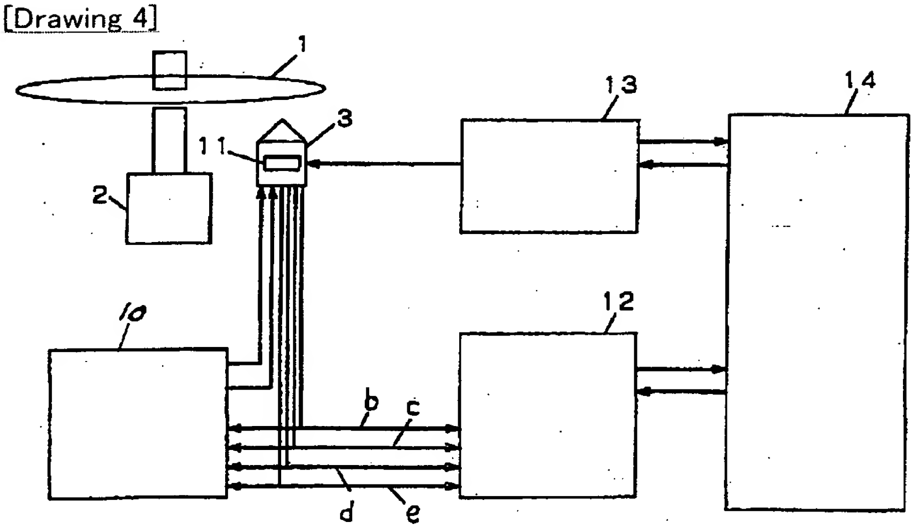
[Drawing 10]



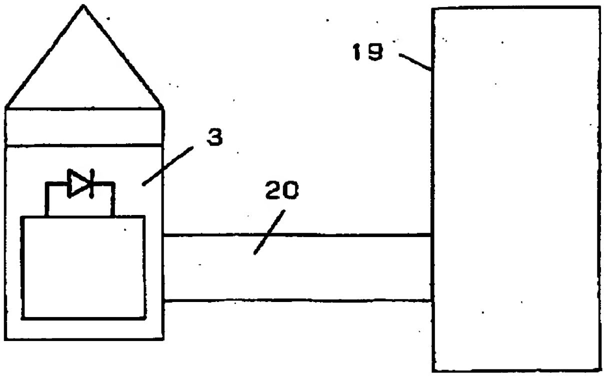
[Drawing 3]



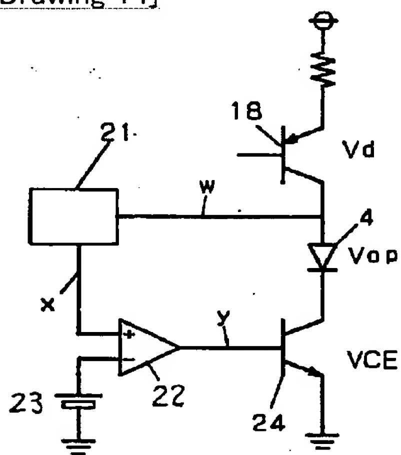
[Drawing 4]



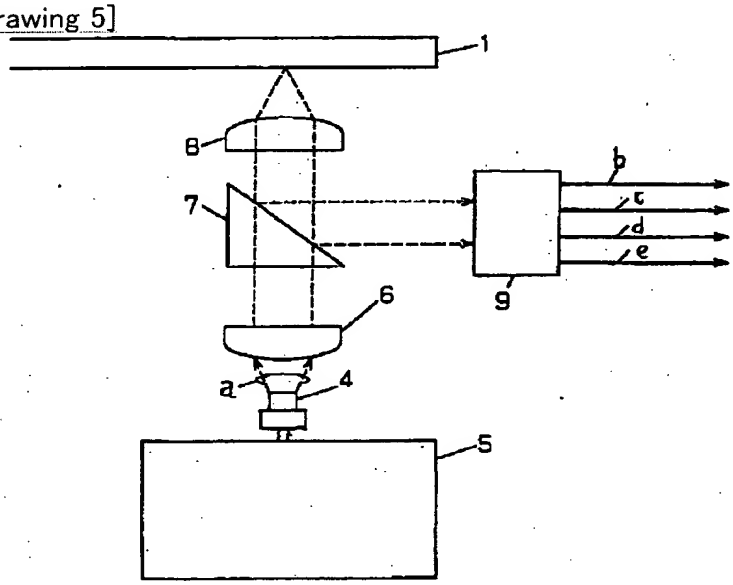
[Drawing 11]



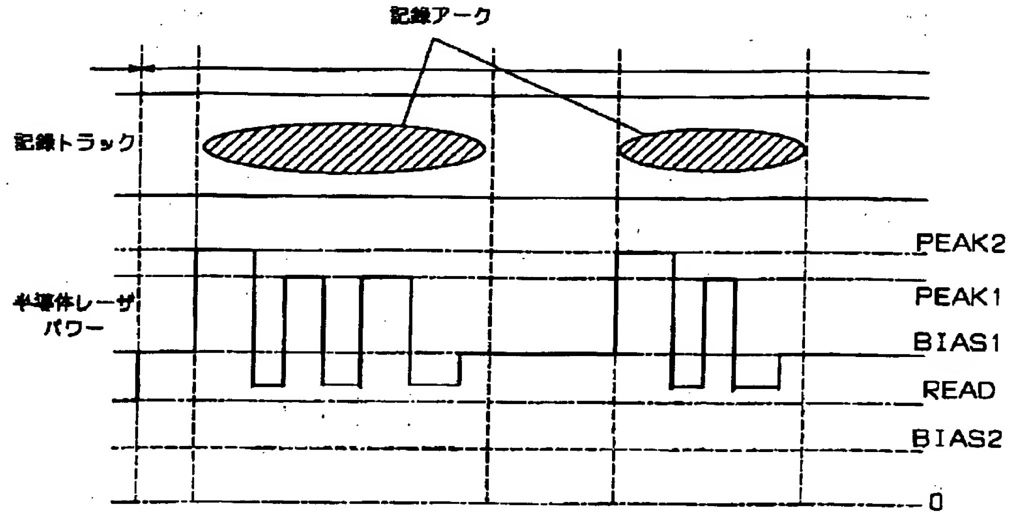
[Drawing 14]



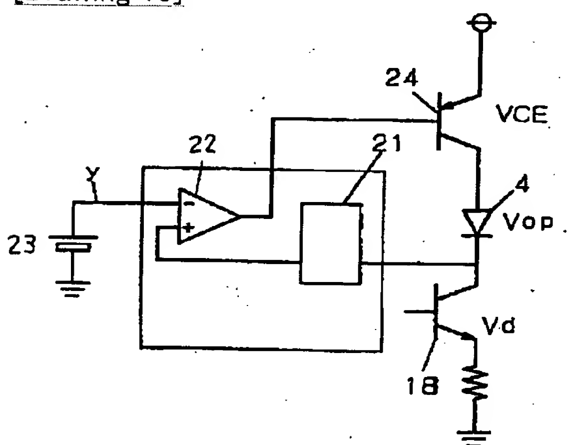
[Drawing 5]



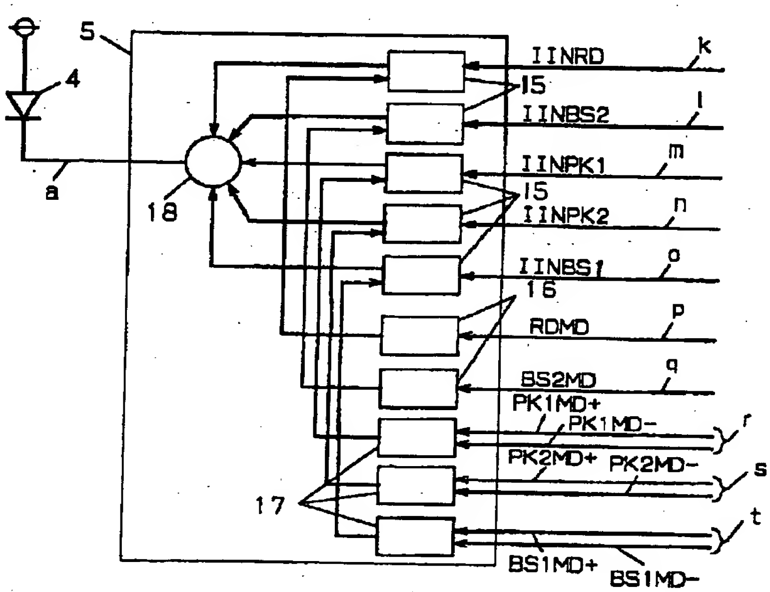
[Drawing 6]



[Drawing 13]



[Drawing 7]



[Drawing 8]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平11－354893

(43)公開日　平成11年(1999)12月24日

(51)Int.Cl.⁶	識別記号	ＦＩ		
Ｈ０１Ｓ　3/18	６３１	Ｈ０１Ｓ　3/18		６３１
Ｇ１１Ｂ　7/125		Ｇ１１Ｂ　7/125		Ｃ
				Ｚ

審査請求　未請求　請求項の数16　ＯＬ　（全 11 頁）

(21)出願番号　特願平11－99681

(22)出願日　平成11年(1999)４月７日

(31)優先権主張番号　特願平10－97254

(32)優先日　平10(1998)４月９日

(33)優先権主張国　日本（ＪＰ）

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　上岡　優一
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　小石　健二
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　宮端　佳之
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　岩橋　文雄　（外２名）

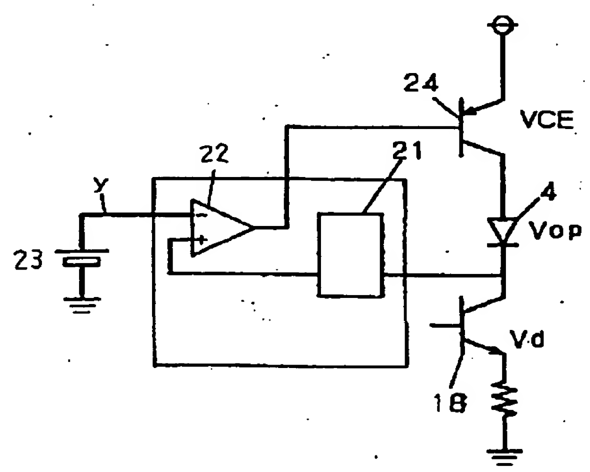
最終頁に続く

(54)【発明の名称】　半導体レーザ駆動装置及び駆動方法

(57)【要約】

【課題】　半導体レーザを搭載した光ピックアップと半導体レーザ駆動装置が分離している方式では、普通、半導体レーザの駆動電流をフレキシブルケーブル等で伝送する。この際、フレキシブルケーブルの寄生容量等によって駆動電流のスイッチング特性が悪化する。

【解決手段】　半導体レーザ駆動部を光ピックアップ上に搭載した構成をとる。この構成では、レーザ駆動電流のために駆動部は熱源となり、光ピックアップの温度上昇を招く。即ち駆動部の省消費電力化が必要である。本案の構成としては、半導体レーザパワー設定用のＮ個の入力信号と、各電流入力値を選択する切り替えタイミング信号入力を設けたレーザ駆動装置で、駆動装置の出力部へ供給する電圧が駆動出力部動作可能最小電圧となるように電源部の電圧を制御する。又電源部は光ピックアップ以外の場所に設定する。



【特許請求の範囲】

【請求項１】　光ディスクを使用してデータの再生およびデータの記録を行うための半導体レーザ駆動装置で、半導体レーザをパルス状に光変調する時の最高周波数ｆ（ｆ＞０）に対して、前記光変調波形の立ち上がり時間Ｔａ（Ｔａ＞０）と立下り時間Ｔｂ（Ｔｂ＞０）の関係がＴａ＜０．５×０．５÷ｆ、　Ｔｂ＜０．５×０．５÷ｆとなるように前記半導体レーザ駆動装置と前記半導体レーザとの間の距離Ｌを５ｃｍ＞Ｌ＞０の条件に近接することを特徴とする半導体レーザ駆動装置。

【請求項２】　前記半導体レーザ駆動装置は光ピックアップと同じ可動部に搭載されていることを特徴とする請求項１記載の半導体レーザ駆動装置。

【請求項３】　前記半導体レーザ駆動装置はＮ個（Ｎは自然数）のレーザパワー設定信号入力部と前記Ｎ値のレーザパワー設定信号を各々選択するためのＮ個の切り替えタイミング信号入力部と前記切り替えタイミング信号にて選択されたＰ個（ＰはＮ以下の自然数）のレーザパワー設定信号を加算するための信号加算部と前記信号加算部によって加算されたＰ個の前記レーザパワー設定信号に応じて、半導体レーザに駆動電流を供給する電流源とを有する請求項２記載の半導体レーザ駆動装置。

【請求項４】　前記Ｎ個のレーザパワー設定信号は電流入力形態をとることを特徴とする請求項３記載の半導体レーザ駆動装置。

【請求項５】　前記Ｎ個の切り替えタイミング信号入力手段のうちＭ個（ＭはＮ以下の自然数）のタイミング信号入力部は差動型の入力形態を有することを特徴とする請求項３記載の半導体レーザ駆動装置。

【請求項６】　前記半導体レーザ駆動装置の半導体レーザ駆動出力部にかかる電圧値を基準値と比較し、一定値に制御するための、電源部と電源部の電圧制御部とを有する請求項３記載の半導体レーザ駆動装置。

【請求項７】　前記半導体レーザ駆動装置出力部にかかる電圧値が前記半導体レーザ駆動装置出力部の動作可能最小値となるように前記電源部を制御することを特徴とする請求項６記載の半導体レーザ駆動装置。

【請求項８】　前記電源部は前記光ピックアップと同じ可動部外に設けられている事を特徴とする請求項６記載の半導体レーザ駆動装置。

【請求項９】　光ディスクを使用してデータの再生およびデータの記録を行うための半導体レーザ駆動方法で、半導体レーザをパルス状に光変調する時の最高周波数ｆ（ｆ＞０）に対して、前記光変調波形の立ち上がり時間Ｔａ（Ｔａ＞０）と立下り時間Ｔｂ（Ｔｂ＞０）の関係がＴａ＜０．５×０．５÷ｆ、　Ｔｂ＜０．５×０．５÷ｆとなるように前記半導体レーザ駆動装置と前記半導体レーザとの間の距離Ｌを５ｃｍ＞Ｌ＞０の条件に近接することを特徴とする半導体レーザ駆動方法。

【請求項１０】　前記半導体レーザの電流駆動部は前記半導体レーザと同じく前記光ピックアップと同じ可動部に搭載されていることを特徴とする請求項９記載の電流駆動方法。

【請求項１１】　前記電流駆動方法でＮ個（Ｎは自然数）のレーザパワー設定信号を入力し、前記Ｎ個のレーザパワー設定信号をＮ個の切り替えタイミング信号で選択し、前記選択されたＰ個（ＰはＮ以下の自然数）のレーザパワー設定信号を加算し、前記加算された設定信号に応じた駆動電流を前記半導体レーザに供給する請求項１０記載の半導体レーザ駆動方法。

【請求項１２】　前記Ｎ値のレーザパワー設定信号を電流入力とすることを特徴とする請求項１１記載のレーザパワー駆動方法。

【請求項１３】　前記Ｎ個の切り替えタイミング信号のうちＭ個（ＭはＮ以下の自然数）の切り替えタイミング信号を差動信号によって伝送することを特徴とする請求項１１記載の半導体レーザ駆動方法。

【請求項１４】　前記半導体レーザ駆動出力部の電圧を観測し、前記観測値をもとに前記半導体レーザと駆動出力部に電流を供給する電源部の電圧を制御し前記半導体レーザ駆動出力部の電圧を一定電圧となるよう制御する請求項１１記載の半導体レーザ駆動方法。

【請求項１５】　前記半導体レーザ駆動出力部への供給電圧を前記駆動出力部の動作可能最小値となるよう制御する請求項１４記載の半導体レーザ駆動方法。

【請求項１６】　前記電源部は前記光ピックアップと同じ可動部外の領域に設けられ、光ピックアップと同じ可動部に搭載された半導体レーザ及び半導体レーザ電流駆動部に電流を供給する事を特徴とする請求項１４記載の半導体レーザ駆動方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、光ディスク装置の光ピックアップに搭載されている半導体レーザ制御に関するものである。

【０００２】

【従来の技術】光ディスク装置は光ピックアップに搭載された半導体レーザを発光し、再生時にはディスク上に微弱な再生光を集光し、ディスク上に記録されているピットの反射率、位相差、偏向角などを検出し読みとり、記録時には再生時より高いパワーで半導体レーザを発光させ、記録する情報に応じてレーザパワーを変調してディスク上に記録し、消去時には記録時にほぼ近いレーザパワーをディスク上に照射し記録部を消去する。

【０００３】例えば相変化型光ディスクへの記録の場合は、基本的にはピークパワーとバイアスパワーの２値をスイッチングし、ピークパワー部でマークを記録し、バイアスパワー部で記録マークの消去を行う。

【０００４】しかし実際には安定した記録マークを形成するためには２値のスイッチングでは不足であり、図１

に示すとおり、記録すべきマークに対し加えられる熱量を均一化する目的やマーク始終端部の熱バランスを調整する目的のために２値以上の複数値のレーザパワースイッチングが必要である。

【０００５】近年光ディスクの記録再生も高速化してきており上記半導体レーザのスイッチング動作にも、より高速性が必要とされる様になってきた。

【０００６】高速記録時において図１に示す記録パルスを実現しようとした時に半導体レーザのパルス波形が十分に高速化されていない場合は、図２に示すようにレーザパワーが所望の波高値まで到達せず、記録マークへの熱量アンバランスが生じ記録マークが歪んでしまう。

【０００７】又、記録マークの前後エッジに情報を持つＰＷＭ記録においては、記録マークのエッジ位置を正確にコントロールする必要があるために、記録パルスの立ち上がり、立下り時間がより短い記録パルスが要求されている。

【０００８】

【発明が解決しようとする課題】従来採用されている半導体レーザを搭載した光ピックアップと半導体レーザ駆動装置が分離している方式では、普通、半導体レーザの駆動電流をフレキシブルケーブル等で伝送する。この場合、フレキシブルケーブルの寄生容量等の分布定数によって駆動電流のスイッチング特性が悪化する。

【０００９】即ち、このスイッチング特性の悪化が光ディスク装置を高速化するに際しての弊害となる。

【００１０】本発明は上記弊害に対する改善と、改善に伴い発生する熱集中化の問題を解決するための省電力化に関するものである。

【００１１】図３は、光ディスク装置の半導体レーザと駆動装置間の導体等に寄生する容量成分と、半導体レーザをパルス状にスイッチングした時の半導体レーザ駆動電流の立ち上がり時間Ｔｒ、立下り時間Ｔｆの関係を示す。

【００１２】上記容量成分に着目すれば、容量成分が増加するに従って、伝送されるパルス電流の高周波成分が半導体レーザに伝送される前に容量を介してバイパスされ、半導体レーザの駆動パルス波形の立ち上がり時間Ｔｒ、立下り時間Ｔｆが大きくなる。すなわち図２に示したような鈍った記録パルスに近づいてくる。

【００１３】仮に、半導体レーザ駆動パルスにおいて最高周波数ｆ１のパルスが必要とされるとすれば、パルス幅は０．５／ｆ１が最小パルス幅となる。従って周波数ｆ１のパルスにおいて、駆動パルスの振幅低下がない条件とは

$$T_r < 0.5 \times 0.5 / f_1,\quad T_f < 0.5 \times 0.5 / f_1 \qquad (式1)$$

となる。

【００１４】例えば最高周波数＝６０ＭＨｚのパルススイッチング実現のためには式１よりＴｒ及びＴｆは共に４．１６ｎｓ以下であることが要求される。

【００１５】図３に示す実験結果からは、Ｔｒ、Ｔｆ＜４．１６ｎｓを実現するためには寄生容量成分を１０ｐＦ以下が必要であると言える。当条件を満たすためには半導体レーザとレーザ駆動部間の距離を５ｃｍ以内に近接化することが必要である。

【００１６】従って高速レーザスイッチングを達成するためにはレーザ駆動装置と半導体レーザ間の分布定数、主に容量成分を低減する目的で、レーザ駆動装置と半導体レーザ間を近接させる、すなわち半導体レーザが組み込まれている光ピックアップ上にレーザ駆動装置を搭載することが必要となる。又は、光ピックアップと同じ可動部にレーザ駆動装置を付設することが必要となる。ただしこの場合問題となるのは半導体レーザとレーザ駆動装置から発生する熱の問題である。

【００１７】光ディスクへのデータ記録時、半導体レーザ駆動電流Ｉｏｐは数１００ｍＡに達し駆動装置出力部にかかる電圧をＶｄ、比例定数をＫ１とすると

$$T_d = K_1 \times V_d \times I_{op} \qquad (式2)$$

の温度上昇が駆動装置に発生する。

【００１８】前述したとおりレーザ駆動装置と半導体レーザとは寄生容量等分布定数の影響を小さくするために近接して配置する必要があるため駆動装置で発生した熱は半導体レーザにも伝導する。

【００１９】半導体レーザの駆動特性は温度によって大きく異なり、高温となるほど駆動電流Ｉｏｐに対するレーザ発光パワーＰの関係（微分効率）は悪化し、より多くの駆動電流Ｉｏｐが必要となり、更に式１から駆動装置の温度上昇を加速させる。

【００２０】又、半導体レーザはそれ自体が発熱源であり、半導体レーザの動作電圧をＶｏｐ、比例定数をＫ２とすれば

$$T_{ld} = K_2 \times V_{op} \times I_{op} \qquad (式3)$$

の温度上昇となる。つまり駆動回路から半導体レーザへの熱の伝導率をＫ３とすれば半導体レーザの温度上昇は

$$T_{ld} = K_2 \times V_{op} \times I_{op} + K_3 \times K_1 \times V_d \times I_{op} \qquad (式4)$$

となる。

【００２１】

【課題を解決するための手段】以上の問題点の解決手段として駆動電流Ｉｏｐの抑制、比例定数Ｋ１，Ｋ２、熱伝導率Ｋ３の抑制、駆動装置出力部にかかる電圧Ｖｄ、Ｖｌｄの抑制が考えられる。

【００２２】Ｉｏｐは半導体レーザ固有の特性であり、比例定数Ｋ１，Ｋ２，Ｋ３は光ピックアップ構成、及び熱設計に依存する。又Ｖｏｐも駆動電流Ｉｏｐによって変動するが、変動量はダイオード電圧と内部直列抵抗によって決まり、基本的に半導体レーザ固有の値である。

【００２３】従ってレーザ駆動装置出力部にかかる電圧

Ｖｄを抑制するすることで光ヘッド部の発熱を抑制する。

【００２４】Ｖｄを抑制するため、レーザ駆動装置出力部に供給する電圧を制御する電源部を設けレーザ駆動装置出力部の電圧を監視し、基準となる電圧と比較しその差分を電源部へフィードバックすることで、常にＶｄが一定値を保ち得る様に制御し、更にレーザ駆動装置出力部が駆動動作可能範囲内でＶｄが最小値になるように電源部の電圧を設定する。

【００２５】上記電源部は半導体レーザ及び半導体レーザ駆動装置が搭載されている光ピックアップ以外の場所に設置する。即ち半導体レーザ部に熱的に関与しない場所に余剰発熱部を隔離する。

【００２６】さらにＡＣライン電圧の変動、負荷の変動、及びその他バラツキなどで光ディスク装置の電源電圧が変動しても常に半導体レーザ駆動装置出力部のＶｄは一定に保たれ光ピックアップ内での発熱はこれらの変動には関係しなくなる。

【００２７】この様にしてレーザ駆動装置出力部にかかる電圧Ｖｄを動作可能最低電圧に保つことで光ピックアップ部での発熱を常に最小状態に制御することが出来、結果として安定した高速化半導体レーザ駆動が実現し得ることになる。

【００２８】

【発明の実施の形態】以下，本発明の実施形態について説明する。

【００２９】図４に光ディスク記録再生装置のシステム構成図を示す。光ディスク１はスピンドルモータ２によって一定方向に回転制御されている。３は光ディスク１にデータの記録再生を行うための光ピックアップである。

【００３０】図５は光ピックアップ３の構成図でレーザ駆動装置を含んでいる。半導体レーザ４はレーザ駆動装置５より供給される駆動電流Ｉｏｐによりレーザ光ａを出力する。半導体レーザ４より出力されたレーザ光ａはコリメートレンズ6により平行光とされ、ビームスプリッタ７を通過し対物レンズ８に入射される。対物レンズ８によってレーザ光は集光され、集光スポットは光ディスク１のデータ記録面にフォーカスされる。

【００３１】記録面で反射されたレーザ光は再び対物レンズ８により平行光となり、ビームスプリッタ７によって光路を変更しフォトディテクタ９に集光される。

【００３２】フォトディテクタ9によって光ディスク１の反射光は電気信号に変換され、図４のサーボブロック１０に入力される。フォトディテクタ９の電気信号に応じて、フォーカス制御、トラッキング制御がなされる。

【００３３】図４、図5で示すｂ，ｃ，ｄ，ｅ即ちフォーカス信号＋、フォーカス信号－、トラッキング信号＋、トラッキング信号－はサーボブロック１０に入力される。サーボブロックではフォーカス信号＋、フォーカス信号－からフォーカス誤差信号、トラッキング信号＋、トラッキング信号－からトラッキング誤差信号が作られる。

【００３４】フォーカス誤差信号、トラッキング誤差信号は電流増幅され光ピックアップ３のアクチュエータ１１に伝えられ、光ピックアップ３の出射光が光ディスク１の記録面上に集光するように位置制御される。

【００３５】また、フォトディテクタ9から出力されるフォーカス信号ｂ、ｃ、トラッキング信号ｄ、ｅは同時に再生信号処理ブロック１２に入力され信号中の高周波帯の信号成分は光ディスク上にピットとして記録されている情報データとして検出される。

【００３６】記録信号処理ブロック１３では外部入力データを光ディスク用に変調、フォーマット変換し、後で示すレーザパワー、タイミング制御を行う。

【００３７】メインコントロールブロック１４は以上の再生信号処理ブロック１３、記録信号処理ブロック１２を制御している。

【００３８】図6には例として相変化型光ディスクにマークを記録するときの半導体レーザのパワーと記録マークを示している。ピークパワー１（ＰＥＡＫ１），ピークパワー２（ＰＥＡＫ２）は光ディスク１上に記録マークを形成するためのパワーである。バイアスパワー１（ＢＩＡＳ１）は下地に記録されたマークを消去するためのパワーである。バイアスパワー２（ＢＩＡＳ２）はマークの熱蓄積を低減するためのパワーである。

【００３９】また、記録しないエリアに関しては、常に再生パワー（ＲＥＡＤ）がオンになる。

【００４０】すなわち、本例では光ディスクへのデータ記録、再生に５値のレーザパワー設定を必要とすることを意味している。

【００４１】図７には半導体レーザ駆動装置の構成図を示している。再生パワー設定電流入力（ＩＩＮＲＤ）、ピークパワー１設定電流入力（ＩＩＮＰＫ１）、ピークパワー２設定電流入力（ＩＩＮＰＫ２）、バイアスパワー１設定電流入力（ＩＩＮＢＳ１）、バイアスパワー２設定電流入力（ＩＩＮＢＳ２）がそれぞれ記録信号処理ブロック１３より電流入力バッファー部１５に入力されている。

【００４２】パワー設定信号は電流入力形態を取ることで電送路のインピーダンスを小さくできフレキシブルケーブル等による長い伝送路においてノイズの影響を最小限にする。なお、上記ＩＩＮＲＤ，ＩＩＮＰＫ1，ＩＩＮＰＫ2，ＩＩＮＢＳ1，ＩＩＮＢＳ２は電流入力が絶対条件ではなく電圧入力形態をとることも可能である。

【００４３】タイミング信号は再生パワータイミング信号（ＲＤＭＤ）、ピークパワー１タイミング信号（ＰＫ１ＭＤ＋、ＰＫ１ＭＤ－）、ピークパワー２タイミング信号（ＰＫ2ＭＤ＋、ＰＫ2ＭＤ－）、バイアスパワー１タイミング信号（ＢＳ1ＭＤ＋、ＢＳ1ＭＤ－）、バ

イアスパワー２タイミング信号（ＢＳ２ＭＤ）である。

【００４４】電流駆動装置内の電流バッファー部１５に入力されたパワー設定電流に対して、パワータイミング信号はイネーブル信号として機能する。

【００４５】図８には図６で示したレーザ発光を実現するためのタイミング信号のスイッチングタイミングを示したものである。再生パワータイミング信号ＲＤＭＤは再生パワー発光時間の間は常にアクティブ状態、バイアスパワー２タイミング信号ＢＳ２ＭＤも記録または消去エリアにおいては常にアクティブ状態であり、スイッチングスピードとして高速性をあまり必要としない。したがって本例では上記２タイミング信号に関してはシングルエンドのタイミング伝送方式をとりシングルエンドロジック入力部１６に入力される。

【００４６】図８中では、ＢＳ２ＭＤはＬレベルをアクティブ状態としている。ピークパワー１タイミング信号ＰＫ１ＭＤ、ピークパワー２タイミング信号ＰＫ２ＭＤ、バイアスパワー１タイミング信号ＢＳ１ＭＤは図８で示すとおり、記録マーク形成時において高速のスイッチングを必要とするタイミング信号であり差動形態をとり、図７に示す差動ロジック入力部に入力される。差動入力の制御信号の演算後の信号をそれぞれ以下のとおり定義する。

【００４７】

ＰＫ１ＭＤ＝（ＰＫ１ＭＤ＋）－（ＰＫ１ＭＤ－）　（式５）

ＰＫ２ＭＤ＝（ＰＫ２ＭＤ＋）－（ＰＫ２ＭＤ－）　（式６）

ＢＳ１ＭＤ＝（ＢＳ１ＭＤ＋）－（ＢＳ１ＭＤ－）　（式７）

図８のＰＫ１ＭＤを例にとるとＰＫ１ＭＤ＋がＨレベル、ＰＫ１ＭＤ－がＬレベルの時をアクティブ状態とする。差動形態のデータ伝送のためフレキシブルケーブル等による長い伝送路においても進入ノイズ成分をキャンセルすることが可能である。又､正論理入力と負論理入力のクロス点が演算結果のエッジ位置となるために、電圧変動や、ノイズによってデューティーの変化が生じたとしても、最終的な差分演算後のデューティーに影響を与えることは少なくなる。

【００４８】記録マークの長さに情報を持たすＰＷＭ記録を採用する光ディスク記録方法では記録パルスのデューティー保存性は極めて重要である。

【００４９】以上定義のもとで、各制御線と、Ｉｏｐの関係を以下のとおりにしめす。

Ｉｏｐ＝Ｇ×（　ＲＤＭＤ×ＩＩＮＲＤ
＋ＰＫ１ＭＤ×ＩＩＮＰＫ１
＋ＰＫ２ＭＤ×ＩＩＮＰＫ２
＋ＢＳ１ＭＤ×ＩＩＮＢＳ１
＋ＢＳ２ＭＤ×ＩＩＮＢＳ２）　（式８）

となる。Ｇは図７の１８に示す電流駆動部のゲインである。

【００５０】以上の様に制御タイミングに高速性を必要とする記録及び消去動作については、タイミング信号を二信号差動式とし、対ノイズ強度を増すことで精度の向上をはかり、又、半導体レーザ駆動信号の作成には加算方式を採用し、最終的に加算合成するまでの分散されたより小さいレベルの各要素電流を取り扱い処理するためバッファ部１５、１６、１７での発熱量及びスイッチング特性等において有利となる。

【００５１】図９、図１０は半導体レーザ電流駆動装置の出力部１８の構成を簡略化して記した図である。

【００５２】図９は半導体レーザ４のカソード側から吸い出す方向に駆動電流Ｉｏｐを供給する方式を示し、図１０は半導体レーザ４のアノード側から流し込む方向に駆動電流Ｉｏｐを供給する方式を示す。

【００５３】レーザ駆動電流Ｉｏｐは数１００ｍＡのオーダであり、光ピックアップ上で消費される電力の大半はレーザ駆動電流Ｉｏｐによるものである。光ピックアップ３上での消費電力は

Ｐ＝ＶＣＣ×Ｉｏｐ　（式９）

であらわす事ができる。ＶＣＣは電源電圧であって、ＶＣＣが最も大きい方向にばらついた時、消費電力が最大となる。ＶＣＣの内訳は図９に示すとおり、半導体レーザ４の動作電圧Ｖｏｐと駆動出力部１８の動作電圧Ｖｄであり、

ＶＣＣ＝Ｖｏｐ＋Ｖｄ　（式１０）

となる。ＶＣＣは図１１に示すとおりメイン部１９からフレキシブルケーブル２０で伝送される事が一般的であり、フレキシブルケーブル上での電圧降下など考えられるが、本例では単純化のため省略している。尚メイン部１９には再生信号処理ブロック１２、記録信号処理ブロック１３、コントロールブロック等が実装されている。

【００５４】又、半導体レーザ４の動作電圧Ｖｏｐは一定ではなく、動作電流Ｉｏｐによって変化する。一般に半導体レーザ内のダイオード電圧Ｖｌｄ、内部抵抗Ｒｓとすれば

Ｖｏｐ＝Ｖｌｄ＋Ｉｏｐ×Ｒｓ　（式１１）

とあらわされる。以上から式９を書き換えると

Ｐ＝（Ｖｏｐ＋Ｖｄ）×Ｉｏｐ　（式１２）
＝（Ｖｌｄ＋Ｉｏｐ×Ｒｓ＋Ｖｄ）×Ｉｏｐ　（式１３）

となる。

【００５５】図１２には半導体レーザ４の出力光パワー

と、駆動電流Ｉｏｐの関係をしめしている。

【００５６】半導体レーザは閾値電流Ｉｔｈ以上の電流に対して微分効率ηを傾きとして、駆動電流Ｉｏｐに比例したパワーを発光する。半導体レーザの上記特性は使用環境温度と、長時間使用による素子の劣化によって変化する。

【００５７】Ｉｔｈ１、η１はそれぞれ常温で且つ使用期間の初期状態の出力レーザパワー対駆動電流の関係を示したグラフであるが、高温時または、長期間の使用後にはＩｔｈ２、η２で示すグラフへと移行する。つまり一定のレーザパワーＰ１を出射するに必要な駆動電流値は前者でＩｏｐ１、後者でＩｏｐ２（Ｉｏｐ１＜Ｉｏｐ２)となる。駆動電流Ｉｏｐが増加すると、式２から式４で示したとおり、レーザ駆動装置５の発熱は増大し、半導体レーザ４の温度が上昇する。温度が上昇すればさらに大きな駆動電流Ｉｏｐを必要とするといった悪循環につながるおそれがあり、光ピックアップ３上での省電力化は重要となる。

【００５８】式９、式１３より光ヘッドの省電力には駆動電流Ｉｏｐを小さくすることが有効であるが、半導体レーザ駆動電流、温度特性、経年変化は半導体レーザ素子への依存が高く制御が難しい。

【００５９】したがって式９からＶＣＣを抑制すること、つまり式１２よりレーザ駆動装置出力部にかかる電圧Ｖｄを抑制することで省電力化が可能となる。

【００６０】図１３、図１４は上記省電力化を盛り込んだレーザ駆動装置出力部の回路である。図１３は図９で示した半導体レーザ４のカソード側より駆動電流Ｉｏｐを引き出す方式のレーザ駆動方法による場合を示す。電圧検出部２１はレーザ駆動装置出力部のトランジスタ１８のコレクタ電圧を検出する。

【００６１】トランジスタ１８のコレクタ電流は記録時はパルス状であり、再生時はＤＣであり、消去時はパルス状であったりＤＣであったりする。従って電圧検出部２１としては、１例として、記録時のピークパワー２、消去時のバイアスパワー１、そして再生時のリードパワーそれぞれの駆動電流が流れている期間に同期したゲート型電圧検出装置が適当である。

【００６２】電圧検出部２１の出力信号は電圧比較部２２で、基準電圧源２３の電圧と比較され、比較結果は電源部トランジスタ２４にフィードバックされ、本例ではトランジスタ１８のコレクタ電圧が記録、消去、再生時それぞれにおいて常に一定電圧に制御される。

【００６３】トランジスタ１８のコレクタ電圧を動作可能最小値、即ちボトミング飽和しない範囲で最小値に設定すれば、レーザ駆動電流出力部における発熱量を最小に維持することが出来る。

【００６４】以上は基準電圧源２３を一定電圧としているが基準電圧源２３を記録、消去及び再生の各モードに対して最適な値に切り替えることも可能である。

【００６５】図１４は図１０で示した半導体レーザ４のアノード側から駆動電流Ｉｏｐを流し込む方式のレーザ駆動方法に省電力化を盛り込んだ例である。図１３の場合と同様に駆動トランジスタ１８のコレクタ電圧を電圧検出部２１が検出し電圧検出部２１の出力は、電圧比較部２２で基準電圧源２３の電圧と比較され、その結果を電源部トランジスタ２４にフィードバックする。

【００６６】図１３で、電源部トランジスタ２４のエミッタ電圧は光ディスク装置の電源電圧であるから、バラツキを生じるが基準電圧源２３は、例えばバンドギャップといった電圧変動の少ないものから構成されているので電源変動に対してもトランジスタ１８のコレクタ電圧は安定している。

【００６７】電源部トランジスタ２４のコレクタ電圧ＶＣＥの変動分ΔＶＣＥによるトランジスタ２４の消費電力の変動分ΔＰＰは

$$\Delta PP = \Delta VCE \times Iop \quad \text{（式１４）}$$

となる。従って電源部トランジスタ２４は光ピックアップより分離した場所、例えば図１１に示すメイン部１９に配置することで光ディスク装置の電源電圧変動分に対しても熱源を光ピックアップ上からメイン部に追いやる結果となる。

【００６８】式９で示したＶＣＣは電源部トランジスタ２４のコレクタ電圧となり、コレクタ電圧をＶＣとすれば

$$P = Vc \times Iop \quad \text{（式１５）}$$

一方、ＶＣ＝Ｖｏｐ＋Ｖｄであるから式１４から

$$P = (Vop + Vd) \times Iop \quad \text{（式１６）}$$

$$= (Vld + Iop \times Rs + Vd) \times Iop \quad \text{（式１７）}$$

となる。Ｖｏｐ、Ｖｌｄ、Ｒｓは半導体レーザ３固有の値であり変化しないため光ピックアップ３の消費電力Ｐも電源変動の影響を受けないことが判る。

【００６９】又、基準電圧源２３の電圧をレーザ駆動装置出力部電圧Ｖｄが動作可能最小値となるよう調整することで、式１６、１７から明らかなとおり光ヘッド上の消費電力の低減が達成される。

【００７０】

【発明の効果】以上、本実施例の様にレーザ駆動装置を半導体レーザが組み込まれているピックアップ上に配置し、レーザ駆動装置出力部にかかる電圧Ｖｄを動作可能最小値に調整することで光ピックアップ上の発熱を最小限に抑えることが出来、多値半導体レーザ電流駆動を安定に高精度に高速化することが可能となる。即ちより高速度な記録再生が実現出来る。

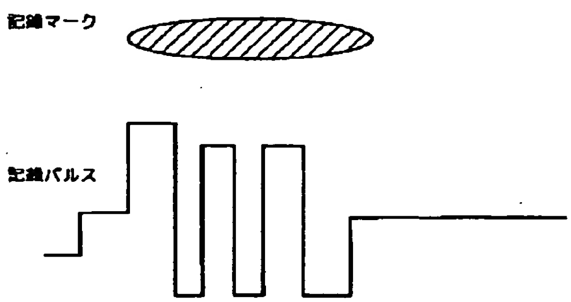
【図面の簡単な説明】

【図１】光ディスクの記録パルス波形と記録マークを示す図

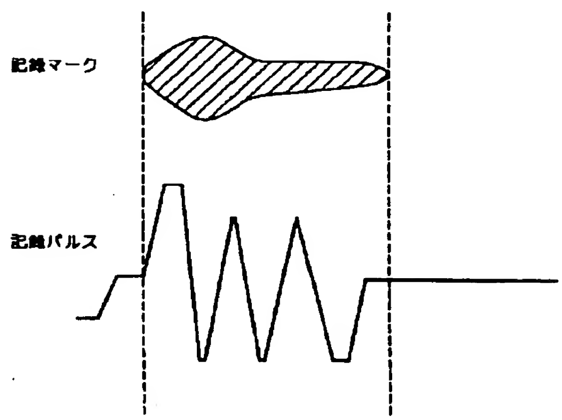
【図２】記録パルスに「なまり」が発生し、振幅が低下した場合の波形と記録マーク例を示す図
【図３】半導体レーザと半導体レーザ駆動部間の導体に寄生する容量と、パルス波形立ち上がり時間Ｔｒと立下がり時間Ｔｆとの関係図
【図４】光ディスクシステム構成図
【図５】光ピックアップ構成図
【図６】光ディスク記録マークと半導体レーザパワー対応図
【図７】半導体レーザ駆動装置構成図
【図８】半導体レーザパワーとタイミング信号対応図
【図９】レーザ駆動装置出力部構成図
【図１０】レーザ駆動装置出力部構成図
【図１１】光ヘッド配置図
【図１２】半導体レーザの出力パワー対駆動電流図
【図１３】省電力レーザ駆動装置出力部構成図
【図１４】省電力レーザ駆動装置出力部構成図
【符号の説明】
1 光ディスク
2 スピンドルモータ
3 光ピックアップ
4 半導体レーザ
5 レーザ駆動装置
6 コリメートレンズ

7 ビームスプリッタ
8 対物レンズ
9 フォトディテクタ
１０ サーボブロック
１１ アクチェエータ
１２ 再生信号処理ブロック
１３ 記録信号処理ブロック
１４ メインコントロールブロック
１５ 電流入力バッファー部
１６ シングルエンドロジック入力部
１７ 差動ロジック入力部
１８ レーザ駆動装置出力部
１９ メイン部
２０ フレキシブルケーブル
２１ 電圧検出部
２２ 電圧比較部
２３ 基準電圧源
２４ 電源部トランジスタ
a レーザ光
b フォーカス信号＋
c フォーカス信号－
d トラッキング信号＋
e トラッキング信号－

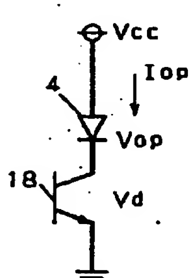
【図１】



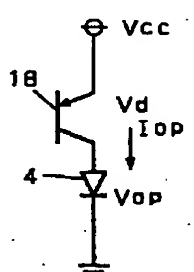
【図２】



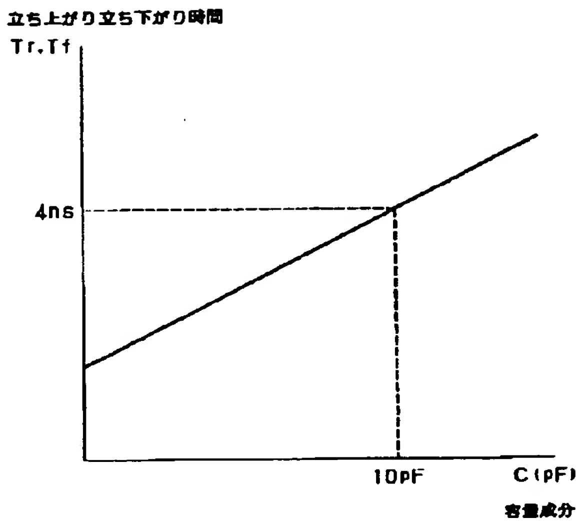
【図９】



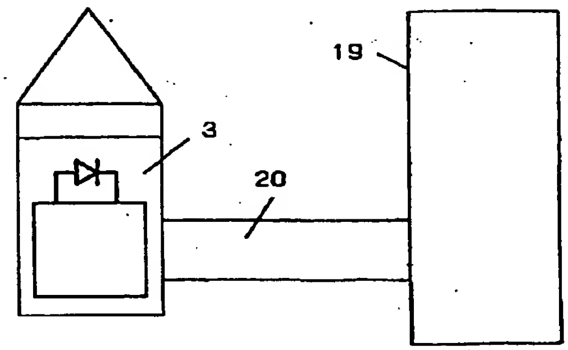
【図１０】



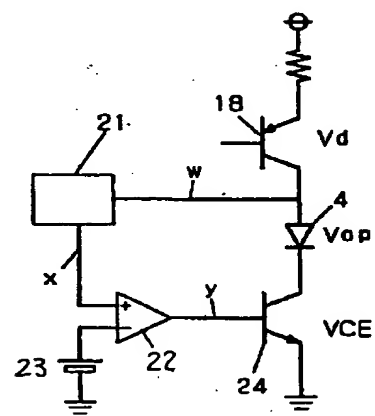
【図3】


立ち上がり立ち下がり時間
Tr,Tf
4ns
10pF
C(pF)
容量成分

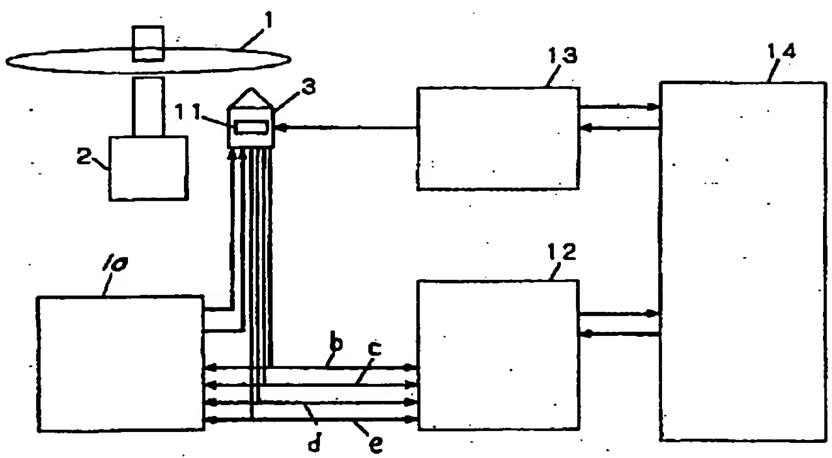
【図11】


19
3
20

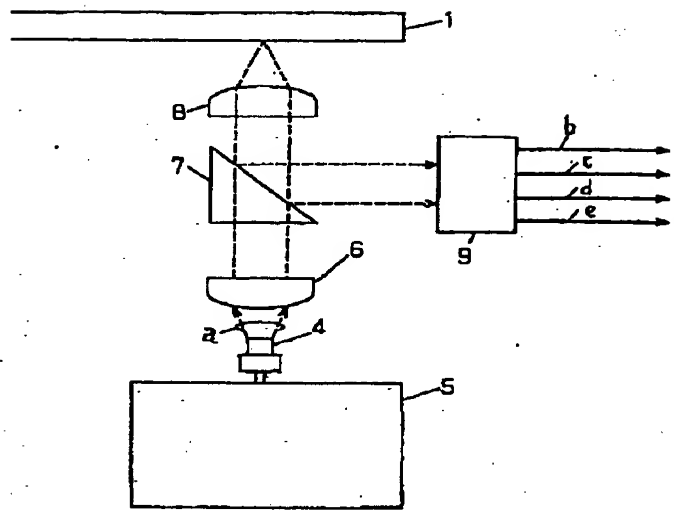
【図14】


18
Vd
21
w
4
Vop
x
y
VCE
23
22
24

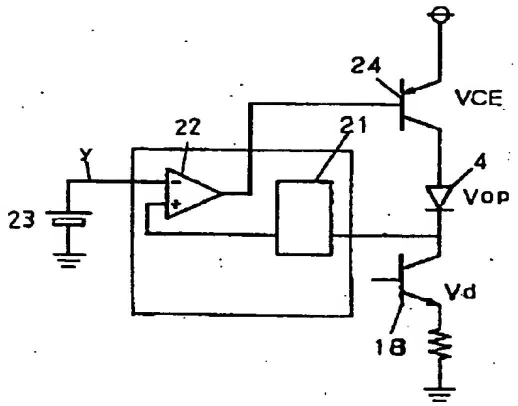
【図4】


1
13
14
3
11
2
10
12
b
c
d
e

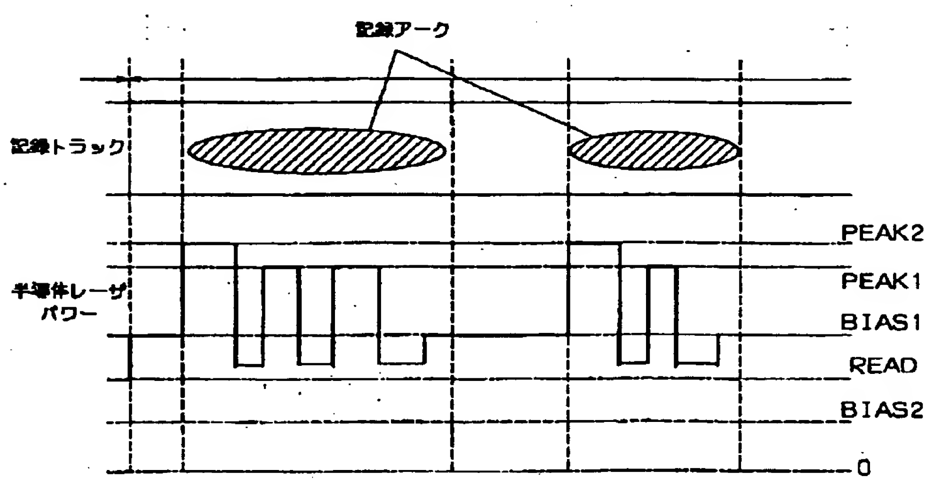
【図５】


1
8
7
b
c
d
e
9
6
a
4
5

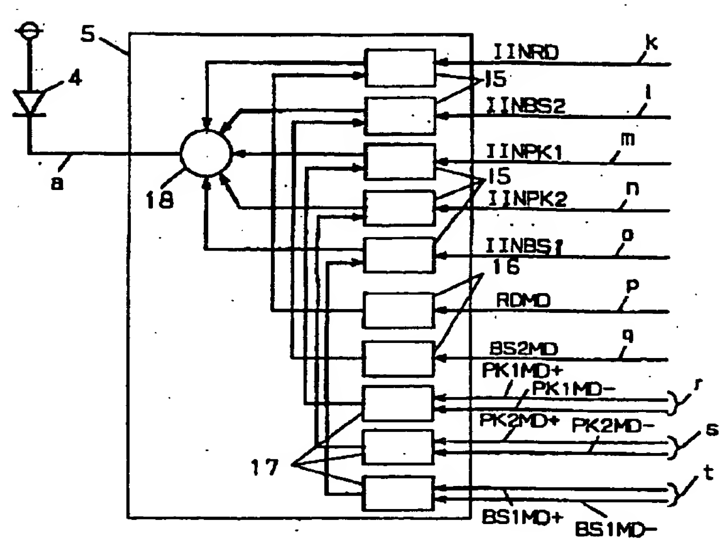
【図１３】


24
VCE
22
21
4
Vop
23
Vd
18

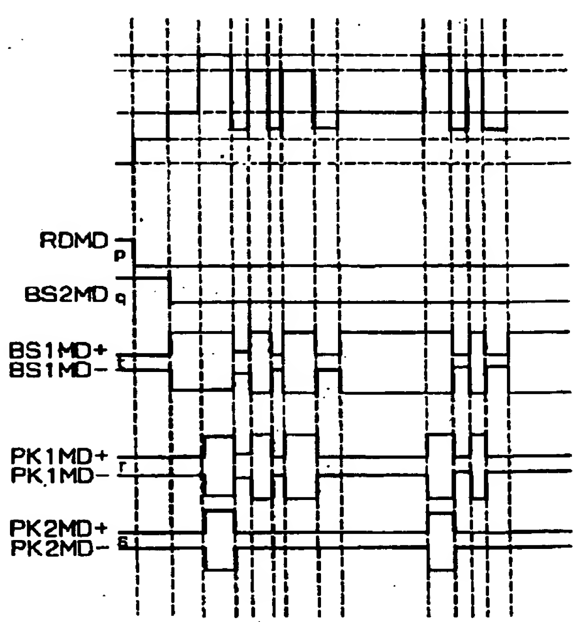
【図６】


記録アーク
記録トラック
半導体レーザ
パワー
PEAK2
PEAK1
BIAS1
READ
BIAS2
0

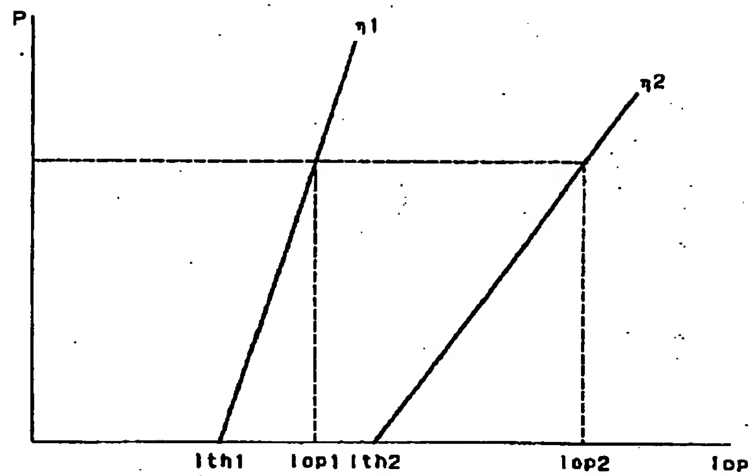
【図７】


5
4
a
18
15
16
17
IINRD
IINBS2
IINPK1
IINPK2
IINBS1
RDMD
BS2MD
PK1MD+
PK1MD−
PK2MD+
PK2MD−
BS1MD+
BS1MD−
k
l
m
n
o
p
q
r
s
t

【図８】


RDMD
p
BS2MD
q
BS1MD+
BS1MD−
t
PK1MD+
PK1MD−
r
PK2MD+
PK2MD−
s

【図12】



フロントページの続き

(72)発明者　中村　尚幸
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　田手原　健一
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　日高　郁夫
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　中森　清
大阪府門真市大字門真1006番地　松下電器産業株式会社内